

DATE: January 23, 2007

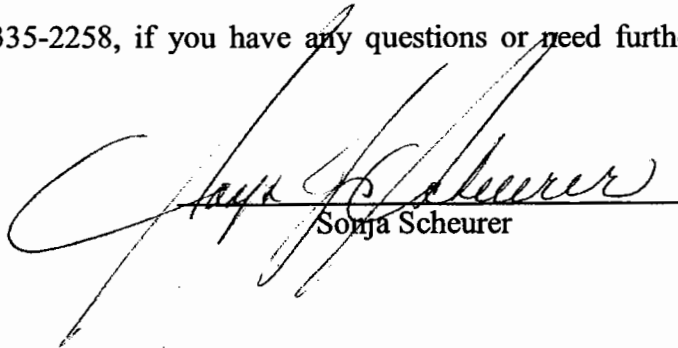
TO: Ed Timpf, Administrator
Financial Operations Division
Bureau of Finance & Administration

FROM: Sonja Scheurer, Administrator
Office of Operations Administrative Services

SUBJECT: Reporting Requirements for FY 2005-2006 and FY 2006-2007
Operating Appropriation Act

In accordance with Public Acts of 2005, Public Act 158, Section 611, and Public Acts of 2006, Public Act 345, Section 611, the department is required to report on the wet reflective pilot project and the use of high-quality pavement marking materials. Attached is a report regarding the status of this program.

Please feel free to contact me at (517) 335-2258, if you have any questions or need further clarification.


Sonja Scheurer

cc: L. Hank
M. Frierson
J. Kraus
File

High-Quality Pavement Marking Materials and Wet Night Retro Reflectivity Pilot Projects

Public Act 158 of 2005, Section 611 and Public Act 345 of 2006, Section 611 states the following:

From the appropriations in part 1, the department shall use high-quality pavement marking materials for all state trunkline projects with a design life of 10 years or greater. The department shall coordinate with material suppliers, equipment manufacturers, and application contractors to ensure cost-effective improvements in durability and retro-reflectivity. The department shall identify pilot projects for demonstration of wet reflective characteristics. The department shall submit a report to both the house and senate appropriations committees and the house and senate fiscal agencies by January 31, 2007, that provides a report on the wet reflective pilot projects and the use of high-quality pavement marking materials in coordination with material suppliers, equipment manufacturers, and application contractors.

Wet Night Reflective Pilot Projects

Painted Shoulder Corrugations (Rumble Strips)-

The Michigan Department of Transportation (MDOT) is the national leader in the area of painted rumble strips or "rumblestrips". This is due not only to the number of miles of painted rumbles or the length of time they've been on Michigan freeways, but also due to the thorough research done by MDOT in conjunction with Michigan State University and Public Sector Consultants. Attached are the following reports that document MDOT's efforts to provide low-cost durable wet night retro reflective markings to drivers on Michigan roadways: **"UPDATE: 3-159(Ex) – Double Line Edge Lines, MIDOT Painted Shoulder Rumble Strips, the Michigan Department of Transportation's Experiences to Date"** and **"Painted Rumble Strips On Michigan Freeways: Driver and Community Perceptions"**.

As of December 2006 painted rumble strips will no longer be considered experimental on Michigan roadways. MDOT's Engineering Operations Committee approved the use of painted rumble strips anytime a shoulder rumble strip is four to eight inches from the edge of a driving lane.

3M Stamark 380© Wet Reflective (WR) Tape used as Traffic Lane Conspicuity Stripes (TLCS)-

The product, 3M Stamark 380©WR tape, commonly called "wet tape", can be seen at night in the rain. It is on the Qualified Product List (QPL) and is available for use as a standard, non-experimental item. The tape is commonly used as a 12 and ½ foot skip line on new construction.

MDOT's Engineering Operations Committee approved a new use for wet tape, which would be more appropriate for older road surfaces. Approval was given for the use of 4 inch wide by 4 foot long strips of wet reflective tape as a substitute for Raised Pavement Markers (RPMs).

RPMs have proven difficult and costly to maintain. Traffic Lane Conspicuity Stripes (TLCS) are a low-cost alternative and can be used on any type road. The tape is placed every 100 feet directly between two skip lines, closer on curves. Using this technique, MDOT can provide an all-weather marking along a roadway centerline without the maintenance issues of an RPM.

Recessed TLCSs are already approved for use. Non-recessed TLCSs have been written into two of the annual pavement marking contracts and will be applied during the 2007 marking season.

All-Weather Paint

A location on US-127 about 10 miles south of Jackson was chosen to pilot 3M® All Weather Paint. This waterborne paint can be seen at night in the rain, is applied at approximately one and a half times the thickness of regular waterborne, and is suppose to last twice as long as regular waterborne under similar conditions. The cost is approximately three times that of waterborne, but waterborne is not visible in a heavy rain. The paint is produced by Ennis® of Ennis, TX and the elements or optics, are produced by 3M®. 3M® All Weather Paint will be released to the full market in 2007.

Initial retro reflectivity numbers on the All Weather Paint were very good; the material will be reviewed again in the spring of 2007.

Polyurea with Wet Night Retro Reflective Elements

The wet reflective element was developed by 3M. It is applied on top of polyurea along with glass beads. Research information provided to MDOT from 3M® indicates the markings should be highly visible even in dark rainy conditions.

There were approximately 50 roadway miles of this product placed in 2006 in five different counties. Some retro reflectivity readings have been taken and will be taken again in the spring of 2007. The readings will be taken for the next few years until the averages indicate restriping is required.

In addition, visual inspection is needed during dark, wet weather conditions to determine the life span of the wet night element feature. Unlike the 380 WR Tape and the All Weather Paint, there has not been a wet night video provided at this time. This product has not been fully released to the market.

High-Quality Marking Materials

In partnership with representatives from the Michigan Infrastructure & Transportation Association (MITA) and members of the Michigan pavement marking industry, a definition of high-quality pavement markings was agreed upon. This agreement led to the issuance of the November 20, 2003 Bureau of Highway Informational Memorandum 2003-17 (BOHIM 2003-17

attached) entitled "Upgrading of Pavement Markings on Future Pavement Construction/Reconstruction Projects".

Polyurea recessed in a groove was identified as a high-quality durable marking. MDOT has taken this requirement further by requiring the use of a large, higher quality reflective system on all new applications of polyurea.

MDOT added another material to the matrix of durable materials. It is called Modified Urethane, and also uses the large bead system. Although not quite as durable as polyurea, it fits into the family of durable markings.

Coordination with Material Suppliers and Application Contractors (Note - Equipment manufacturers work directly with suppliers and application contractors.)

- MDOT met with contractors and suppliers in Gaylord, Michigan on Tuesday, August 29, 2006, to discuss interests and concerns relative to all areas of the pavement marking program. Discussions were about durable materials; application issues; retro-reflectivity measurements; and MDOT, contractor, and supplier goals and concerns.
- MDOT worked with representatives of 3M. Their Stamark 270 IES© Primerless Patterned Tape was allowed to be used in lieu of overlay cold plastic tape on the QPL as the installation time of the material is less, thus less exposure to the worker and less delay to the driver.
- MDOT set up pilot projects to evaluate wet night retro reflective polyurea in 2006 by coordinating with suppliers, contractors and MDOT Personnel.
- MDOT placed 3M©All Weather Paint test deck by coordinating with application contractor, supplier and MDOT Personnel.

MDOT recognizes the need for quality pavement markings. As the population ages, upgraded pavement markings will prove beneficial, not only to the older driver, but to all drivers.



JENNIFER M. GRANHOLM
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF TRANSPORTATION
LANSING

KIRK T. STEUDLE
DIRECTOR

August 11, 2006

W. Scott Wainwright, P.E., PTOE
Highway Engineer, MUTCD Team
Federal Highway Administration
Office of Transportation Operations, HOTO-1 400 Seventh Street, SW, Room
3408 Washington, DC 20590

Re: UPDATE: 3-159(Ex) – Double Line Edge Lines MIDOT
Painted Shoulder Rumble Strips
The Michigan Department of Transportation's Experiences to Date

Dear Mr. Wainwright,

The Michigan Department of Transportation (MDOT), in a letter dated June 19, 2003, requested permission to experiment with the use of a double line edge line. Permission was granted in a letter dated July 17, 2003, signed by Mr. Vincent Pearce. The department was given permission to study the use of a double line edge line for four years.

In the original work plan MDOT stated the intention of providing semi-annual updates; however, this is the first official status report. I apologize for the delay in reporting.

The attached report is a narrative of the events that have taken place since the pilot project began. Included is information on research MDOT has done in conjunction with Michigan State University (MSU) and Public Sector Consultants (PSC), a policy research corporation.

This narrative also provides a chronology of MDOT's efforts to provide low-cost durable wet night retro reflective markings to drivers on Michigan roadways while attempting to stay within parameters of the *Manual on Uniform Traffic Control Devices*.

Please call me at 517-373-3340 if you have comments or would like to discuss any aspect of the report contents.

Sincerely,

Jill G. Morena, P.E.
Pavement Marking Engineer
Michigan Dept. of Transportation

Enclosure(s)



JENNIFER M. GRANHOLM
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF TRANSPORTATION
LANSING

KIRK T. STEUDLE
DIRECTOR

Report to the FHWA: Experimental Use of a Double Line Edge Line for Wet Night Retro Reflectivity

Introduction:

The Michigan Department of Transportation (MDOT) requested permission from the Federal Highway Administration (FHWA) to experiment with the use of a double line edge line. Permission was granted in July, 2003. The department was given permission to study the use of a double line edge line for four years.

This is the first official status report.

Following is a narrative of the events that have taken place since the pilot project began. Included is information on research MDOT has done in conjunction with Michigan State University (MSU) and Public Sector Consultants (PSC), a policy research corporation.

This narrative also provides a chronology of MDOT's efforts to provide low-cost durable wet night retro reflective markings to drivers on Michigan roadways while attempting to stay within parameters of the *Manual on Uniform Traffic Control Devices*.

Painted Shoulder Rumble Strip Pilot Project:

The shoulder rumble strip milling and striping project began on several freeways in the Grand Region in the summer of 2003. This is an area on the western side of Michigan and includes Ionia, Kent, Mecosta, Montcalm, Muskegon, Newaygo, Oceana, and Ottawa counties.

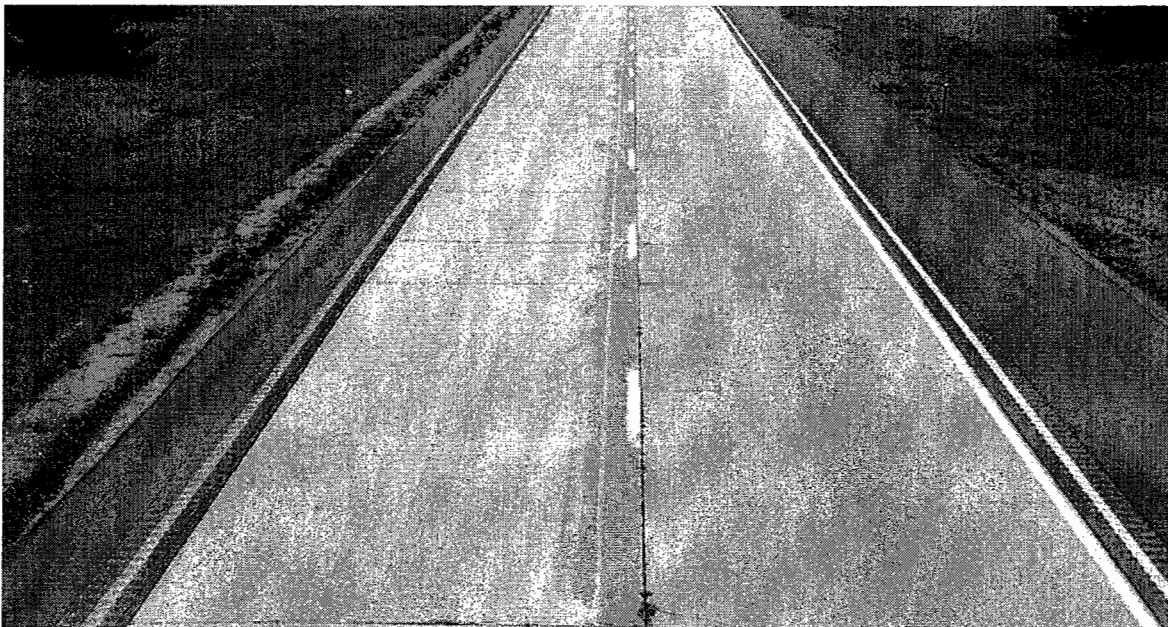
At the time, MDOT's standard location for milled rumbles was 24 inches from the edge of pavement joint line on the right shoulder, 12 inches on the left. (Figure 1.)

Figure 1 MDOT Previous (2003) Standard Rumble Strip Offset – 24” Right Shoulder



For the pilot project, approximately 596 shoulder miles of rumble strip were milled, 400 miles at the pilot offset of 4 inches from the joint line. Approximately 200 shoulder miles were striped with the experimental double line edge line pattern. (Figure 2)

Figure 2 4”Rumble Strip Offset, Experimental Double 4” Edge Line



The other 200 miles were striped with MDOT's preferred pattern, a six inch edge line placed directly on the rumble strip. (Figure 3) Note in Figure 3 that the existing edge line has been ground off, and though still slightly visible in daylight, is not visible at night.

Figure 3 4" Rumble Strip Offset, 6 Inch Edge Line



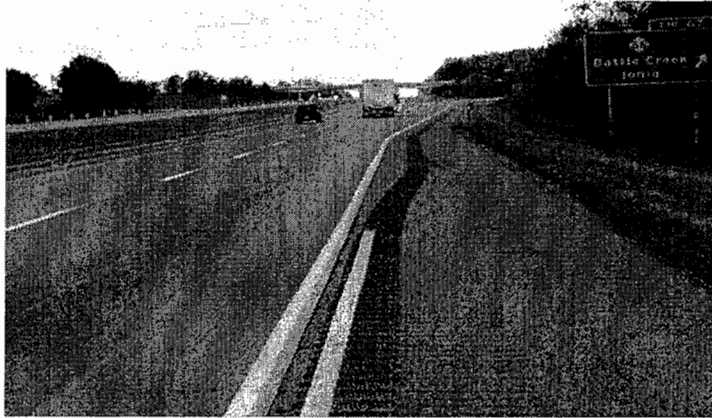
The project progressed quickly. Calls from residents complaining about increased noise from vehicles hitting the painted rumbles started to come in almost immediately.

Two types of locations seemed to be the biggest noise generators. Exit ramps were one. At one ramp in particular, approximately 70 percent of exiting vehicles hit the rumble strips. This led to a change in milling specifications mid-project. It also required some rumble strips to be filled and pavement markings removed to remedy the situation.

Figure 4 Original Exit Milling Standard



Revised Exit Milling Standard



The second type of noise generator was the preferred marking. We noticed numerous complaints came from locations where the 6 inch line was in the rumble strip and residents lived near the freeway. In one location, rumble strips were milled where there previously had been none. The homes in the area backed up to the right of way fence. This area was to be gapped out of the project but was fitted with the experimental painted rumble in error. This location in particular generated numerous complaints. Information gathered later in the Vehicle Positioning/ Noise Generation Research confirmed the traffic stream followed the paint line into the rumble strip.

While complaints were almost all noise related, two people did mention being surprised that driving on the edge line meant driving in the rumble strip.

There was no specific public comment, positive or negative, about the two parallel four inch edge line markings.

Research:

MDOT undertook three research projects to look at various aspects of the painted rumble strip initiative, two while the project was ongoing and the other one year after completion.

Reflectivity Research Project – MDOT and Michigan State University (MSU) were in the midst of a research project dealing with retro reflectivity and paint durability. That project was initiated four years prior, with part of the focus being the microphotography of glass bead embedment in waterborne paint and sprayable thermoplastic on MDOT roads. That study lead MSU to suggest MDOT look at a textured surface upon which to apply paint. This was happening just as Mississippi was noting the wet night retro reflective benefits of painting an edge line on a rumble strip. A rumble strip appeared to be the ultimate textured surface, and it seemed painting it might be even more beneficial in a snowplow state.

The original installation was done in August 2002 and for the past four springs the four year old waterborne line has continued to have a higher retro reflectivity reading than the one year old marking next to it! (Figure 5) .

Figure 5 **Original test location, after one winter, wet night**



Figure 6 shows the experimental double 4 inch edge line during a steady rain. Both lines are new. The line in the rumble strip is brighter and easier to see than the regular edge line.

Figure 6 Grand Region Pilot Project, Wet Night, Experimental Double 4" Edge Line



Following are some of the conclusions from the MSU research:

1. The main advantage of painted rumble strips is the dramatic increase in retro reflectivity under wet-night conditions.
2. Paint inside a rumble strip is protected from snowplows, so is more durable.
3. Initial retro reflectivity for a painted rumble strip is generally the same as that for a flat surface painted with the same material, provided enough material is applied.
4. Field observations showed the milled surface of a rumble strip requires two applications of waterborne paint to be effective. The rough surface absorbs the first application.

Vehicle Positioning / Noise Generation Project:

Another MSU research project to evaluate the painted rumble strip pilot project in Grand Rapids was the Vehicle Positioning Study. The research looked at the effect of the two marking patterns on the way vehicles positioned themselves in the driving lanes. Separate noise measurements were also taken.

Data was taken at sample sites on the 100 miles of pilot roadway, as planned. However, there were some problems with the software and some of the data collection for the 2003 sites, and some of the data from the sites conflicted with each other, making SOME project conclusions iffy. We still benefited, overall, from the large amount of information taken on these sites, and several important study conclusions were derived from this original data. However, some of the strongest conclusions that come from this study, come from the addition of a new study site, discussed below.

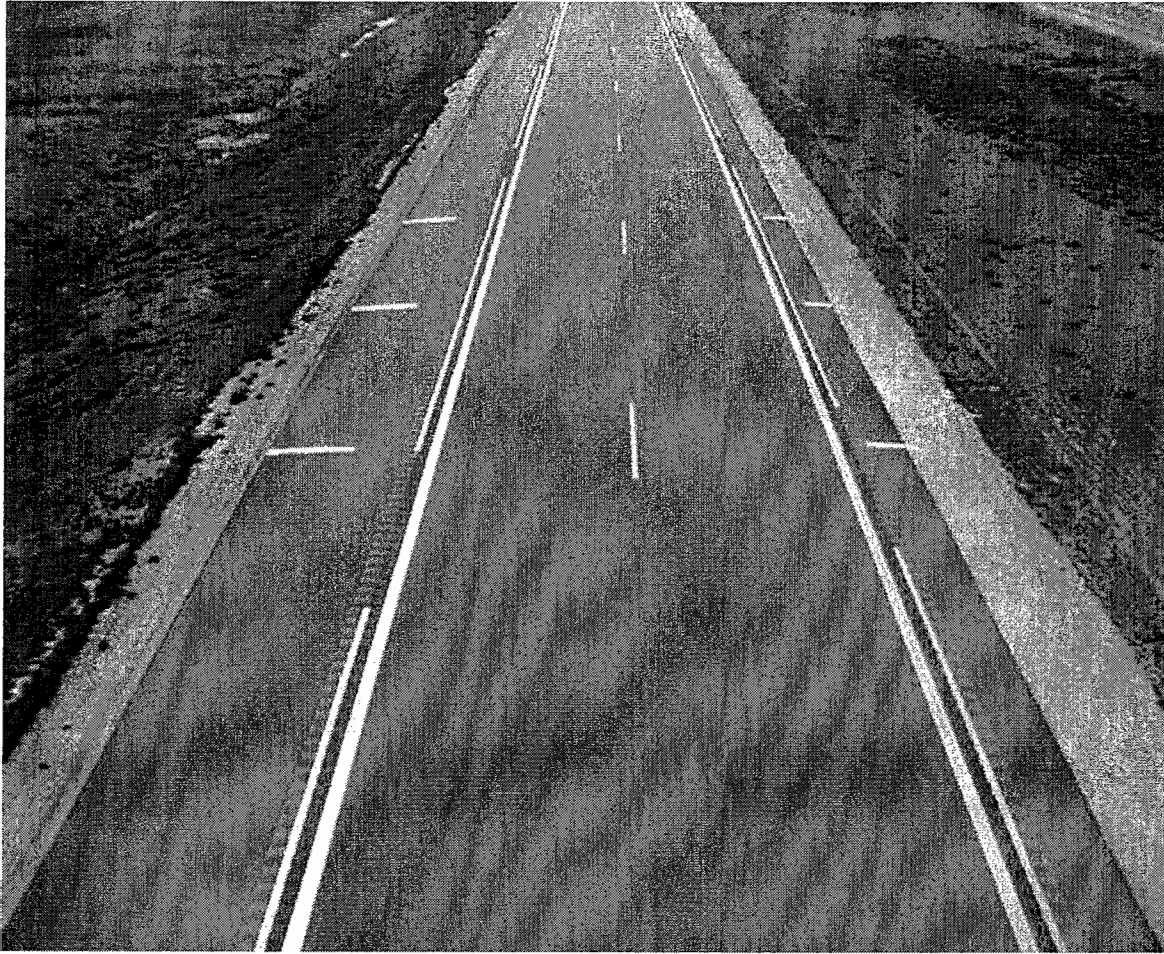
Because of a few inconsistencies in the original data, as mentioned above, the vehicle positioning research project was expanded to include another location. An 11-mile stretch of freeway, US-131 near Manton, Michigan, on new alignment had been built in 2003. The rumble strips were milled at the 4 inch offset and painted with the preferred 6 inch single edge line. During the first year of operation, numerous complaints were received regarding noise to residents living in the vicinity, from vehicles hitting the rumble strip.

Due to noise complaints, and in keeping with early information from the vehicle positioning research, MDOT decided to re-stripe this 11-mile stretch to provide the two-stripe marking scheme. However, by this time several changes had taken place in MDOT policy and practice. First, MDOT had adopted a 6' edge line for all trunkline routes. Second, MDOT had become interested in differentiating our 2-stripe marking scheme from other 2-stripe schemes, by varying the width of the stripes. Therefore, the 2-stripe scheme which we applied to the Manton US -131 freeway location, 11 miles, all shoulders, both directions – was not two 4" lines. We applied a 6" line in normal position, on the edge of the through lane, coupled with a 3" line applied on top of the rumble strip. For further differentiation, the 3" line was gapped at an 80' paint, 20' gap cycle.

After application of the new marking scheme in the Manton area, the noise complaints from residents along the test section ceased. In fact, the department received a letter from a citizen praising MDOT's remediation of the noise issue.

One complaint was received from a driver saying they considered the appearance of the 80 foot line with the 20 foot gap to be too busy. MDOT personal agreed the line was unusual looking and so piloted another shoulder rumble strip marking, the 6 inch standard edge line in the standard location with a solid 3 inch line approximately 8 to 10 inches from this line, just in the edge of the rumble strip.

Figure 7 6'edge line, 3'rumble line - 80' long, 20' gap (MANTON RE-STRIPING)



Among the conclusions of the Vehicle Positioning Study:

1. The effect of grinding off the existing 4 inch white edge line and replacing it with a 6 inch line in the rumble strip approximately 4 to 6 inches to the right had the effect of moving the entire traffic stream to the right. This put the entire traffic stream closer to the shoulder and closer to the rumble strips. This resulted in hits occurring with a smaller driver distraction or shorter driver drowsy spell than would otherwise have resulted in rumble contact. This means incidental hits increased with the single line in the rumble concept.
2. The safety benefits of moving the shoulder rumble strip closer to the travel lane (from the previous 24 inches offset on the right, 12 inches left) can be obtained without a significant increase in the number of noise spikes if the double line pavement marking is used.

3. A double paint line appears to positively affect the driver's ability to guide the vehicle around a curve.
4. Traffic generally travels further from the shoulder when the double line pattern is used, keeping the weight of traffic from the weakest part of the pavement.

Driver and Community Perception Research:

Finally, about a year after the rumble strips were milled and painted, Public Sector Consultants (PSC), a policy research corporation, worked with MDOT to develop a questionnaire which was sent to 10,000 households within two miles of the freeway in the Grand Region. Questions were asked of them as both residents and drivers. There were questions about the perceived safety benefits of rumble strips, the noise they generate, and how those relate to the residents' quality of life. (A copy of the survey is attached.)

One of MDOT's goals was to see if, as drivers, they noticed the experimental marking patterns and, if so, whether the line patterns meant anything out of the ordinary to them. Of particular interest was whether or not drivers thought the white double line edge line pattern meant it was illegal to cross over to the shoulder.

On Michigan trunklines there are very few instances of the use of a double white line. There is one location in the Grand Region where a double white line is used. It is less than half a mile long, and is accompanied by a sign reading 'DO NOT CROSS DOUBLE WHITE LINE'. When MDOT's research firm, PSC, surveyed the public about the three pavement marking patterns, this question was an interesting issue.

The surveys were sent November 1, 2005, and returned December 1, 2005. Approximately 1,500 households responded. Small focus groups of professional drivers were also interviewed.

The findings indicate:

As residents –

1. Sixty-one percent believed the noise level had remained the same in the past year, 27 % thought it had increased some.
2. Seven respondents had registered some type of complaint about the noise generated from rumble strips, four had complained about highway noise in general.
3. Residents are most aware of highway noise when working in the yard.
4. Although noise from the freeway can be heard by most people, it's not enough to cause them to relocate.

As drivers-

When asked if they had noticed the various marking patterns in their travels, most drivers did (60%).

When asked if any of the three pictured marking patterns meant anything to them as far as whether or not it was legal to use the shoulder, the response to each marking pattern was approximately the same, no matter whether there was one line, two solid lines or two lines, one of them gapped. Forty-five percent believed Michigan traffic law says the shoulder is available for use, 25% percent believe it is prohibited from use.

The wording of the question was discussed a number of times. The researchers at PSC made the point that MDOT's concern was beyond most drivers' concerns; that a driver will seek refuge on a shoulder no matter what marking pattern is used. The researchers concluded there was no confusion for the drivers with any of the marking patterns due to the fact the question elicited the same response to each pattern.

Other responses;

1. Fifty-eight percent of drivers recalled seeing the 6" line with the 4" line in the rumble, 60 percent had seen the 6" line in the rumble; only 23 percent recalled seeing the experimental pattern with the 80' line, 20' gap. (This makes sense as the 80' line, 20' gap marking was added to only one location in the Grand Region for the purposes of the research.)
2. Respondents feel rumble strips are important for safety purposes.
3. Most agree they have been drowsy or distracted and been alerted by a rumble strip.
4. Those who have noticed painted rumbles believe they improve road visibility at night in the rain.
5. Forty-one percent of residents preferred the marking pattern with the 6" edge line on the pavement and 3" solid shoulder rumble strip marking (SRSM), 34 percent preferred the 6" edge line on the pavement and 3" gapped SRSM, while only 24 percent preferred the single 6 inch edge line in the rumble strip.

Changes to MDOT practice and standards:

Based on information collected for this research study, and other information which has become available, MDOT has made several changes to their striping and rumble strip policy during the course of this study:

Wider Edge Line Marking

In January 2004, MDOT adopted six inches as the standard width for all edge lines used on state roadways. Research from around the country indicated a wider line increased visibility distance and provided better guidance to all drivers, both old and young.

Solid 3" Shoulder Rumble Strip Marking (SRSM)

In April 2005, a decision was made that when a Region or Transportation Service Center (TSC) wanted to include low cost wet reflective pavement markings on a project, the use of a solid 3" SRSM rather than the 80' line with the 20' gap would be allowed.

Standard Rumble Strip Location

In October 2004, with information from NYDOT and the PA Turnpike showing the safety benefits of locating shoulder rumbles nearer the traveled lane and the preliminary results of the MDOT/MSU Vehicle Positioning and Noise Study, MDOT changed their standard rumble milling location to be 6 inches from edge line, left and right. It had been 24" from the joint on the right shoulder, 12 inches off on the left. The 6 inches also allows 2 more inches leeway between the joint and rumble strip for increased shoulder strength and reduction of incidental vehicle hits, versus the 4 inch offset used in the Grand Region.

This offset will allow future painting of the shoulder rumble strip marking on many miles of Michigan freeway, providing drivers a durable, wet night retro reflective edge line marking at a very low cost.

Manual of Uniform Traffic Control Devices

The Michigan State Advisory Committee was in the process of reviewing and revising parts of the national 2003 *Manual on Uniform Traffic Control Devices* (MUTCD) for adoption as the 2005 *Michigan Manual on Uniform Traffic Control Devices* (MMUTCD). We were aware the national definition of a double line was a concern with our experimental striping system. During this time, we attempted to differentiate our experimental system from common national uses of double lines, by controlling the widths to 6" edge line, 3" rumble line. In keeping with this strategy, MDOT at this time revised the Michigan MUTCD to reflect that width difference. Wording in Section 3A.05 in the 2005 Michigan Manual was modified from national wording to specifically define a double line as "two parallel lines of equal width separated by a discernable space." Thus, in Michigan at least, the 6"/3" line system we are using is not in conflict with the MUTCD definition of "double line."

Increased Use of Two-line Marking System Throughout the State

By 2005 more interest was generated around the state in using the painted rumble strip line. Its use has increased, although it's still not a standard practice. There are approximately 350 shoulder miles of the two- line pattern in place as of August 2006. There are approximately 150 shoulder miles of the formerly preferred 6" rumble stripe pattern..

While the 6 inch edge line, three inch shoulder rumble strip marking is a good combination, MDOT is considering increasing the SRSM to 4 inches for better visibility.

Figure 8 6" Edge Line, 3" Shoulder Rumble Strip Marking (SRSM)

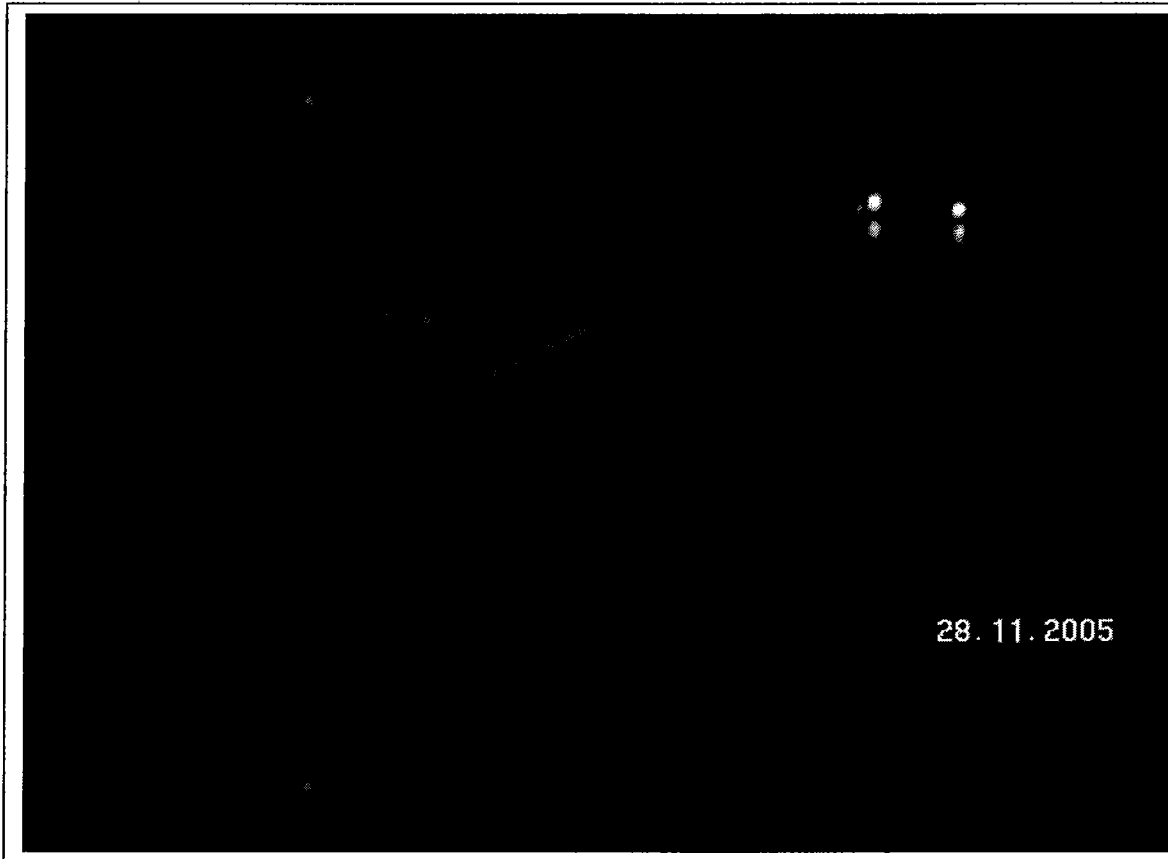


Conclusion -

The pilot painted rumble strip project has proven beneficial. The department started with a one mile stretch of roadway where the wet-night retro reflectivity and paint durability of painting rumble strips was clearly demonstrated. Information was gathered on 400 miles of painted rumble strips with various paint patterns. MDOT, along with our research partners has gathered vehicle positioning data, noise data and driver and resident input. This has documented that an edge line on the roadway can function along with a line in the rumble strip, both serving a purpose and helping a driver navigate the roadway. Wet night visibility and pavement marking durability can be provided at a low cost without causing pavement joint damage, driver confusion, or an undue amount of noise.

The department plans to further encourage use of pavement markings in the rumble strip to benefit wet night visibility for the driving public. The design standard that we propose is a 6" edge line in normal edge line position, with a 4" shoulder rumble strip marking. Separation between the two lines is currently 8 to 10 inches and we propose to continue using this spacing.

Bob Clark, Retired Pavement Marking Contractor: "...miles of I-75 and all you can see is the yellow marking in the rumble strip."



Jill G. Morena, P.E.
Pavement Marking Engineer
Michigan Department of Transportation
August 15, 2005

MDOT Painted Rumble Strip Survey

Residents

INTRODUCTION

Between 2003 and 2005, the Michigan Department of Transportation (MDOT) installed painted rumble strips and pavement markings on approximately 160 miles of freeway in the greater Grand Rapids area.

A rumble strip is a length of indented pavement parallel to the direction of travel that causes your car's tires to vibrate as a warning that you are leaving the road.

Approximately half of these rumble strips were installed according to existing MDOT guidelines, while the other half were installed using a variation in the location of the rumble strip and painted edge lines.

An edge line is a solid painted line, between 4 and 6 inches wide, that runs parallel to the direction of vehicle travel that separates a driving lane from the shoulder. Edge lines on the right-hand side of the travel direction are white; edge lines on the left side of the travel direction are yellow.

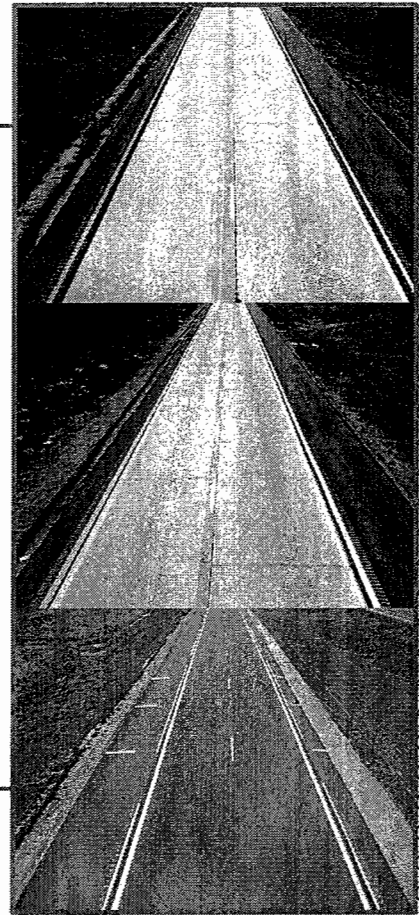
MDOT is interested in your perceptions of these painted shoulder rumble strips, both as a user of roads in the area as well as a homeowner near these roads.

MARKING INSTRUCTIONS

- Use a No. 2 pencil only.
- Do not use ink, ballpoint, or felt tip pens.
- Make solid marks that fill the response completely.
- Erase cleanly any marks you wish to change.
- Make no stray marks on this form.

CORRECT: ●

INCORRECT: ☒ ☓ ○ ○



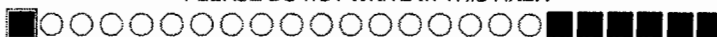
GENERAL OBSERVATIONS/AWARENESS OF RUMBLE STRIPS

1. Prior to reading the definition above, did you know the purpose of shoulder rumble strips?
 - a. Yes (Y)
 - b. No (N)
 - c. Don't know/unsure (?)
2. In general, do you think that putting shoulder rumble strips on highways and interstates is a very good idea, somewhat good idea, somewhat bad idea, or very bad idea?
 - a. Very good idea (A)
 - b. Somewhat good idea (B)
 - c. Somewhat bad idea (C)
 - d. Very bad idea (D)
 - e. Don't know (E)

REACTION TO RUMBLE STRIPS AS A MOTORIST

3. Think about the freeways in your general area—that is, all of the state highways (such as M-52) and federal interstates (such as I-96). As you travel on these roads, have you ever seen, heard, or felt rumble strips on the road edge or shoulder?
 - a. Yes (Y)
 - b. No (N)
 - c. Don't know/cannot remember (?)

PLEASE DO NOT WRITE IN THIS AREA

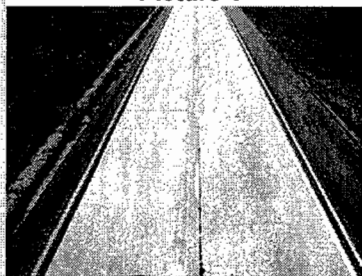


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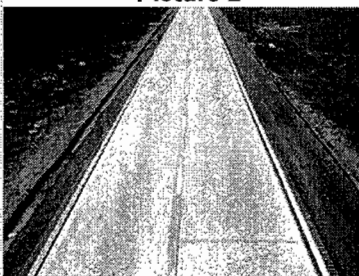
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Picture 1



An edge line on the road, a parallel line in the rumble strip.

Picture 2



A single line in the rumble strip.

Picture 3



An edge line on the road, a parallel dashed line in the rumble strip.

4. Have you ever seen the following types of painted rumble strips? (See images above.)
- | | Yes | No | Don't know |
|--------------|-------------------------|-------------------------|-------------------------|
| a. Picture 1 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| b. Picture 2 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| c. Picture 3 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
5. Have you ever seen one of these patterns at night in the rain?
- | | Yes | No | Don't know |
|--------------|-------------------------|-------------------------|-------------------------|
| a. Picture 1 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| b. Picture 2 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| c. Picture 3 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
- If you answered "No" or "Don't know" to all three, skip to question 6b.
- 6a. Was the visibility of the line in the rumble strip enhanced in comparison to the edge line on the road?
- | | Yes | No | Don't know |
|--------------|-------------------------|-------------------------|-------------------------|
| a. Picture 1 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| b. Picture 2 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| c. Picture 3 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
- 6b. If you knew that a paint line placed on a rumble strip enhanced the visibility of the paint line at night in the rain, which of the three paint patterns would you prefer to see used on Michigan's roadways?
- | | |
|--------------|-------------------------|
| a. Picture 1 | <input type="radio"/> A |
| b. Picture 2 | <input type="radio"/> B |
| c. Picture 3 | <input type="radio"/> C |
| d. Other | <input type="text"/> |
7. Which of the following best describe the benefits that you believe the painted shoulder rumble strips add to Michigan roads? (Check all that apply.)
- | | |
|--|----------------------------|
| a. Improve the visibility of the road at night. | <input type="checkbox"/> A |
| b. Provide warning to drowsy drivers | <input type="checkbox"/> B |
| c. Alert inattentive drivers who stray off the highway surface | <input type="checkbox"/> C |
| d. Improve a driver's ability to see the road edge when conditions reduce visibility (such as during rain or snow) | <input type="checkbox"/> D |
| e. Other | <input type="text"/> |
8. Please mark whether you agree or disagree with each of the following statements.
- | | Strongly agree | Somewhat agree | Neutral/ no opinion | Somewhat disagree | Strongly disagree | Don't know |
|--|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| a. I use the interstate to get to work and am largely unaware of the rumble strips. | <input type="radio"/> A | <input type="radio"/> A | <input type="radio"/> A | <input type="radio"/> A | <input type="radio"/> A | <input type="radio"/> A |
| b. I was drowsy and hit the rumble strips and they alerted me. | <input type="radio"/> B | <input type="radio"/> B | <input type="radio"/> B | <input type="radio"/> B | <input type="radio"/> B | <input type="radio"/> B |
| c. The rumble strips have warned me when I was distracted on the interstate highway. | <input type="radio"/> C | <input type="radio"/> C | <input type="radio"/> C | <input type="radio"/> C | <input type="radio"/> C | <input type="radio"/> C |
| d. I feel safer using the interstate because of the rumble strips. | <input type="radio"/> D | <input type="radio"/> D | <input type="radio"/> D | <input type="radio"/> D | <input type="radio"/> D | <input type="radio"/> D |
| e. I don't like the rumble strips because of the noise made when I drive over them. | <input type="radio"/> E | <input type="radio"/> E | <input type="radio"/> E | <input type="radio"/> E | <input type="radio"/> E | <input type="radio"/> E |
| f. The rumble strips are unimportant. | <input type="radio"/> F | <input type="radio"/> F | <input type="radio"/> F | <input type="radio"/> F | <input type="radio"/> F | <input type="radio"/> F |

9. Based on the paint patterns shown on page 2 and your understanding of Michigan traffic law, is the use of the shoulder legal or illegal?

	Legal	Illegal	Don't know
a. Picture 1	(A)	(A)	(A)
b. Picture 2	(B)	(B)	(B)
c. Picture 3	(C)	(C)	(C)

LOCATION OF HOME/RESIDENCE

10. From your home (that is, at the address where you received this survey), can you hear any noise from the nearest highway or interstate?

- a. Yes (Y)
b. No (N)
c. Don't know (?) } **Skip to question 23.**

11. In general, how loud is the noise from the nearest highway or interstate? Use a 1 to 5 scale, with "1" being a *little noise* and "5" being *very loud and intrusive*. (1) (2) (3) (4) (5)

12. In general, how often do you hear the noise from the nearest highway or interstate? Use a 1 to 5 scale, with "1" being *very rarely* and "5" being *almost constant*. (1) (2) (3) (4) (5)

13. In general, what types of noises do you hear from the nearest highway or interstate?

- Do you hear ...
a. Truck engines (A)
b. General traffic sounds (B)
c. Horns (C)
d. Radios (D)
e. Road noise from tires (E)
f. Rumble strips (F)
g. Accelerating/slowing traffic (G)
h. Other

14. At what times of day do you most frequently hear noise from the nearest highway or interstate?

- a. Monday-Friday before 8:00 a.m. (A)
b. Monday-Friday 8:00 a.m.-12:00 p.m. (B)
c. Monday-Friday 12:00 p.m.-5:00 p.m. (C)
d. Monday-Friday 5:00 p.m.-12:00 a.m. (D)
e. On weekends (E)

15. Where in or near your house are you most aware of the noise?

- a. Working outside in the yard (A)
b. Indoors (B)
c. In your car (C)
d. Other

16. In a normal week, what are the most typical time periods that you are at home?

- a. Monday-Friday before 8:00 a.m. (A)
b. Monday-Friday 8:00 a.m.-12:00 p.m. (B)
c. Monday-Friday 12:00 p.m.-5:00 p.m. (C)
d. Monday-Friday 5:00 p.m.-12:00 a.m. (D)
e. On weekends (E)
f. Other

17. In the past year, do you think the level of noise from the nearest highway or interstate has ...

- a. Increased dramatically (A)
b. Increased some (B)
c. Stayed about the same (C)
d. Decreased some (D)
e. Decreased dramatically (E)
f. Don't know (F)

QUALITY OF LIFE

18. Has the noise from **rumble strips** ever caused you to ...

- a. Close the windows in your home to limit the noise? (Y) (N) (?)
b. Spend less time doing outdoor activities (e.g., barbecuing, yard maintenance, sports, etc.)? (Y) (N) (?)
c. Write a letter to or call MDOT or a government official? (Y) (N) (?)

19. Has the noise from **the nearest highway or interstate** caused you to ...

- a. Close the windows in your home to limit the noise? (Y) (N) (?)
b. Spend less time doing outdoor activities (e.g., barbecuing, yard maintenance, sports, etc.)? (Y) (N) (?)
c. Write a letter to or call MDOT or a government official? (Y) (N) (?)

20. Throughout the year, are you more aware of the noise from **rumble strips** in the...

- a. Spring (A)
b. Summer (B)
c. Fall (C)
d. Winter (D)
e. No difference (E)
f. Don't know (F)

21. Throughout the year, are you more aware of the noise from **the nearest highway or interstate** in the ...

- a. Spring (A)
b. Summer (B)
c. Fall (C)
d. Winter (D)
e. No difference (E)
f. Don't know (F)

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22. Please read the following statements. *For each statement, mark whether you strongly agree, somewhat agree, somewhat disagree, or strongly disagree.*

Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
(A)	(A)	(A)	(A)
(B)	(B)	(B)	(B)
(C)	(C)	(C)	(C)
(D)	(D)	(D)	(D)
(E)	(E)	(E)	(E)

23. In general, when you think about your experience traveling on roads that have shoulder rumble strips, which statement comes closest to your reaction?

- a. I am pleased with them. (A)
b. I want them removed. (B)
c. They add to the safety of the highways. (C)
d. No comment/unsure/I haven't thought much about them. (D)

BACKGROUND INFORMATION

The following information is collected for statistical purposes only.

24. Approximately how far is your residence from the nearest state highway or interstate, drawing a straight line?

- a. Less than 1/4 mile (A)
b. 1/4 to 1/2 mile (B)
c. 1/2 to 1 mile (C)
d. More than 1 mile (D)
e. Don't know/unsure (E)

25. Which age category are you in?

- a. 18–24 years old (A)
b. 25–34 years old (B)
c. 35–44 years old (C)
d. 45–54 years old (D)
e. 55–64 years old (E)
f. 65–74 years old (F)
g. 75 years old or older (G)

26. What is your employment status? Are you ...

- a. Employed outside the home full time (A)
b. Employed outside the home part time (B)
c. Working at home or retired (C)
d. Other (D)

27. Are you currently taking education or skill-building classes toward a degree?

- a. Yes (Y)
b. No (N)
c. Don't know (?)

28. Are there any children under the age of 18 living in your household?

- a. Yes (Y)
b. No (N)
c. Don't know (?)

29. What is the highest level of education you have completed?

- a. Incomplete high school (A)
b. High school graduate/GED (B)
c. Vocational/technical school or an associate's degree (C)
d. Some college (D)
e. College graduate (E)
f. Postgraduate study or degree (F)
g. Don't know (G)
h. Prefer not to say (H)

30. What is your gender?

- a. Male (A)
b. Female (B)

Thank you!

PLEASE DO NOT WRITE IN THIS AREA



[SERIAL]

Painted Rumble Strips on Michigan Freeways: Driver and Community Perceptions

Survey Results and Analysis

May 2006

Prepared for
Michigan Department of Transportation
Lansing, Michigan

Prepared by
Public Sector Consultants Inc.
Lansing, Michigan
www.pscinc.com

The mission of the Michigan Department of Transportation is to "provide the highest quality transportation for economic benefit and improved quality of life." MDOT is committed to providing the best transportation options possible via road, air, or rail. To reach this goal, MDOT encourages public involvement in all phases of transportation improvement: planning, project selection, and construction. In addition, the agency seeks to communicate regularly with the public regarding construction activities and possible delays and MDOT products and services. It promotes public education about the transportation planning process and, where possible, assesses the effectiveness of its programs.

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Executive Summary

In February 2005 MDOT hired Public Sector Consultants Inc. (PSC) to assess motorist and resident perception of painted rumble strips on Michigan freeways and assess driver behavior and preferences as well as community perceptions. PSC conducted the evaluation using a survey and focus group interviews—written surveys for residents who live close to the freeways and focus group interviews of commercial fleet drivers including law enforcement officials.

The assessment included:

- A targeted survey of residents living within two miles of the freeways containing the new painted rumble strips, to evaluate their perceptions of noise and other quality-of-life issues that are associated with the rumble strips as well as to gauge their reaction to the strips as users of the freeway
- Focus group interviews with frequent users of the freeways (e.g., commercial fleet drivers and law enforcement officials) to determine whether they have noticed the painted rumble strips and to evaluate their experience driving on the freeways on a regular basis
- Identification of areas of concern
- A summary of findings

PSC conducted the survey of residents between Tuesday, November 1, 2005, and Thursday, December 1, 2005; 10,000 residential surveys were mailed. More than fifteen hundred surveys were returned, for a response rate of 15.3 percent. The margin of error for the survey is ± 3.5 percent at the 95 percent confidence level.

In addition to surveying residents in close proximity to the designated rumble strip areas, PSC gathered information from frequent users of the identified freeway segments. A total of 33 drivers representing five different companies and two law enforcement agencies participated in the focus group discussions between December 7, 2005, and January 15, 2006. At the focus group sessions, pictures of each of the three types of painted rumble strips were displayed. Participants were asked a series of questions related to the overall safety and perceived effectiveness of rumble strips, including their visibility at night and during inclement weather.

RESULTS

Results of the survey and focus group interviews reveal that, by a wide margin, painted rumble strips are accepted and supported by Michigan motorists. Ninety-seven percent of survey respondents are aware of rumble strips and 84 percent believe that they are a very good idea. Generally, motorists are aware of only two of the three types of experimental painted rumble strips; the first is an edge line on the road with a parallel line in the rumble strip; the second is a single line in the rumble strip. The third type, an edge line on the road and a parallel dashed line in the rumble strip, is recognized by approximately 23 percent of respondents; another 41 percent are not sure whether they have seen this type of rumble strip marking. When respondents were asked if they have ever seen the three

different rumble strip patterns at night in the rain, between one-third and one-half of the respondents are unsure whether they have seen any of the three patterns.

HOUSEHOLD SURVEY: MAJOR FINDINGS

- Ninety-seven percent of those surveyed are aware of the purpose of the rumble strips.
- In general, most survey respondents are very positive about the rumble strips. About 84 percent “strongly” or “somewhat” agree that the rumble strips warn them when they are distracted while driving and 77 percent feel safer because of the rumble strips.
- Four out of five respondents think that rumble strips increase the vigilance of drowsy or inattentive motorists (81 percent and 80 percent, respectively).
- Improving the visibility of the road edge at night is an additional benefit noted by about 71 percent of respondents, and nearly two-thirds believe that rumble strips improve drivers’ ability to see the road edge when visibility deteriorates during rain and snow.
- Respondents are able to recognize two types of experimental rumble strip markings—an edge line on the road with a parallel line in the rumble strip and a single line in the rumble strip—at rates of 58 percent and 60 percent, respectively. The third type of marking, an edge line on the road with a parallel *dashed* line in the rumble strip, is familiar to less than one-quarter (23 percent) of the respondents.
- When shown the different marking schemes, a plurality (43 percent or more) believes that use of shoulders as depicted in all three pictures is legal, compared to 25 percent or fewer who believe such use of the shoulders is illegal.
- Asked to choose their preferred pattern after being told that painted rumble strips enhance their visibility at night, the highest percentage of respondents (41.3 percent) chose the pattern in which there is an edge line on the road and a parallel line in the rumble strip.
- A majority of respondents (53 percent) can hear noise from the nearest highway or interstate. Eighty percent of residents closest to the highway (0.5 mile or less) report hearing noise. This percentage declines to 30 percent for residents living 1.5 to 2 miles from the interstate or highway.
- The level of noise from the rumble strips has minimal impact on most respondents. Ninety-one percent do not feel the need to close windows to limit the noise from the rumble strips. Only a few spend less time outside or have written a letter to MDOT to complain because of rumble strip noise (1.9 and 1.0 percent, respectively).

FOCUS GROUP INTERVIEWS: MAJOR FINDINGS

- Rumble strips generally make commercial drivers feel safer on freeways.
- Primary benefits of rumble strips include alerting inattentive and drowsy motorists.
- Most motorists are not aware of the different types of experimental marking patterns used on the rumble strips in the study area.
- Drivers recommend that an optimum placement of rumble strips is 8–14 inches from the edge line. Placement of the rumble strip less than 8 inches from the edge line

increases the incidence of tire contact with rumble strips by motorists, who have a tendency to overcorrect and cross the centerline, creating unsafe conditions.

- Rumble strips are particularly effective during winter months by helping drivers delineate the road edge in snow-covered conditions.
- To enhance safety, drivers recommend that MDOT improve maintenance of painted edge lines and centerlines; while rumble strips provide early notification to a driver veering off the freeway, painted edge lines provide an important visual cue for lane orientation and for navigating the freeway safely.
- Edge line visibility could be enhanced with reflective vinyl or placement of reflective pucks or discs similar to those used in Indiana.
- Tractor-trailer drivers indicate that rumble strips can be an annoyance in construction zones as drivers are often forced to drive on the rumble strips when the road shoulder is used as an alternate driving lane.
- Rumble strips alert law enforcement personnel making routine traffic stops on the freeway to cars that stray onto the shoulder, adding a considerable safety benefit. The same is true for motorists that must change a flat tire on the freeway shoulder.
- While not directly related to rumble strips, there is consensus that a wider freeway shoulder would enhance overall safety.
- Law enforcement personnel suggest that in addition to painted rumble strips, MDOT should provide more and higher visibility signage on Michigan freeways to enhance safety. For example, Michigan freeways should contain signage that instructs motorists to use the right lane at all times except when passing.
- Law enforcement personnel also recommend that MDOT increase the number of public service announcements about driving laws that apply to Michigan freeways.
- Commercial and law enforcement personnel are extremely pleased that MDOT undertook this study and sought their input to help make Michigan's freeways safer.

Background

Between 2003 and 2005, the Michigan Department of Transportation (MDOT) installed painted rumble strips and pavement markings on approximately 160 miles of freeways¹ in seven counties in the Grand Rapids region. Approximately half of these rumble strips were installed according to existing MDOT guidelines, while the other half were installed using a variation in the location of the rumble strip and painted edge lines. A rumble strip is a length of indented pavement parallel to the direction of travel that causes a car's tires to vibrate as a warning that the vehicle is leaving the road. An edge line is a solid painted line between 4 and 6 inches wide, running parallel to the direction of vehicle travel, that separates a driving lane from the shoulder. Edge lines on the right-hand side of the travel direction are white; edge lines on the left side of the travel direction are yellow.

Public Sector Consultants Inc. (PSC) was hired by the MDOT in February 2005 to assess the public reaction to painted shoulder rumble strips on Michigan freeways. The focus of the study was on two distinct driving populations:

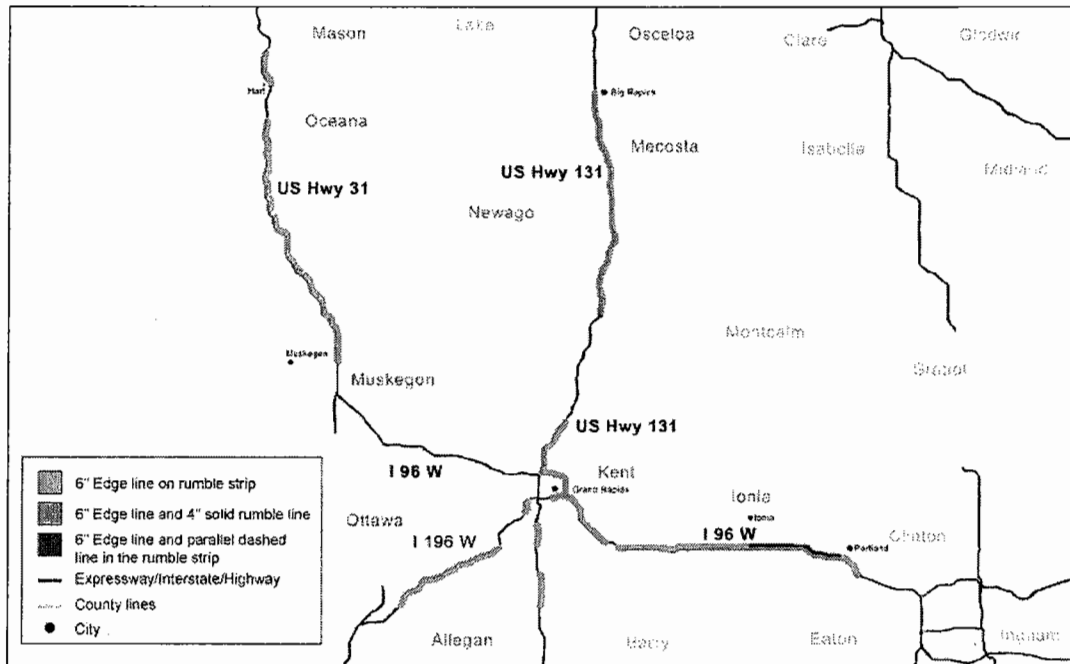
- Residents whose homes are near the freeway—to evaluate their perceptions of noise and other quality-of-life issues that are associated with the rumble strips as well as to gauge their reaction to the strips as users of the interstate
- Frequent users of the interstate, including commercial fleet drivers (e.g., U.S. Postal Service, Spartan Stores)—to determine whether they have noticed the painted rumble strips and to evaluate their experience driving the interstate on a regular basis

MDOT was interested in understanding the perceptions of both automobile and commercial fleet truck drivers, as well as homeowners that live within two miles of selected freeways. The department was particularly interested in knowing whether the experimental marking patterns with an edge line on the pavement and an auxiliary marking in the rumble strip led drivers to believe that the road shoulder should not be used for emergency purposes. The location of the experimental rumble strip markings is shown in Exhibit 1.

¹PSC recognizes that the terms “freeway,” “interstate,” and “highway” have specific meaning for transportation planners and professionals. To simplify this report, PSC will use these terms interchangeably to refer to all the areas where these rumble strips have been installed.

EXHIBIT 1

MDOT Rumble Strip Placement



SOURCE: Public Sector Consultants Inc.

Survey Methodology and Results

METHODOLOGY

To understand and evaluate the effects of the experimental painted rumble strips, two distinct groups of people were surveyed. First, residents of households within two miles of the freeway containing the experimental strips were surveyed to measure any increased awareness of the nearby rumble strips. These people also were assumed to be frequent highway users and were asked if they had noticed the painted rumble strips as part of their commuting/driving in the area containing the strips.

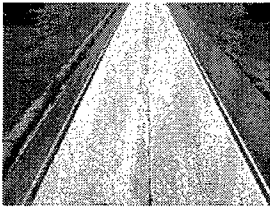
Second, MDOT wished to measure the effect of the painted rumble strips on other frequent users of the highway, specifically commercial fleet drivers. This assessment was a more complicated undertaking, as freeway users do not make themselves known as they travel over a specific segment of interstate or state road. Therefore, the following groups were asked to participate in focus groups and evaluate their experiences traveling the identified segments of road on a regular basis:

- Fleet transport truck drivers for major companies (e.g., Spartan Stores)
- Regional delivery trucks (e.g., U.S. Postal Service)
- Local public safety agencies (e.g., Kent County Sheriff, Michigan State Police)
- Bus drivers (commercial)

The photographs of the three styles of painted rumble strip markings shown in Exhibit 2 were displayed during the focus groups and reproduced in the survey.

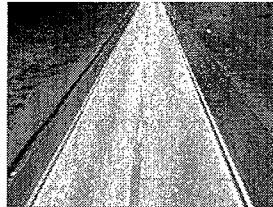
EXHIBIT 2

Experimental Rumble Strip Markings



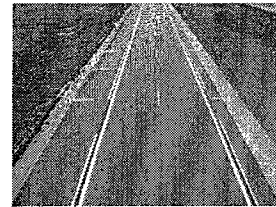
Picture 1

An edge line **on** the road,
a parallel line **in** the rumble strip.



Picture 2

A single line **in**
the rumble strip.



Picture 3

An edge line **on** the road, a parallel
dashed line **in** the rumble strip.

SOURCE: Public Sector Consultants Inc.

Survey

Each survey packet was distributed through the U.S. mail, and included:

- A cover letter written by PSC on PSC letterhead
- A four-page survey
- A postage-paid, business reply envelope to return the survey to PSC

Drawing the Sample

To reach the homes within two miles of the freeway, PSC used TIGER-based GIS software to locate the precise sections of interstate in the 11 Michigan counties where the experimental painted rumble strips were located. Once these areas were identified, PSC created buffer regions of 0.5, 1, 1.5, and 2.0 miles around these sections and generated a list of Zip+4 Codes contained in the buffer regions. These Zip Codes—60,000 in all—were sent to a commercial database supplier to generate a count of the number of residential mailing addresses in each of the Zip+4 regions.

In four counties—Allegan, Clinton, Mason, and Newaygo—a total of only 680 residential addresses were identified because these counties contain very small portions of the study areas. In comparison, in the other seven counties more than 110,000 residential addresses were identified; a majority (more than 80,000) were in Kent County alone. Therefore, PSC excluded the four counties with the smallest counts from the survey sample.

To draw the final stratified random sample, PSC combined the seven counties into five groups so that no group had fewer than 3,000 residences; this step was necessary to ensure the best possibility that surveys sent to each of the five geographic areas would result in valid data for each individual region. PSC then instructed the commercial database supplier to randomly draw residential addresses in the following quantities for each area:

- Oceana and Muskegon Counties: 1,250 addresses
- Montcalm and Mecosta Counties: 1,250 addresses
- Ionia County: 1,250 addresses
- Ottawa County: 1,250 addresses
- Kent County: 5,000 addresses

The resulting file contained all valid addresses within the buffer areas.

The resident household survey was conducted between Tuesday, November 1, 2005, and Thursday, December 1, 2005, by PSC. PSC received completed surveys from 1,530 Michigan residents in the seven-county region for a response rate of 15.3 percent. The margin of error for the survey is ± 3.5 percentage points at the 95 percent confidence level.²

Questions in the survey were grouped in five main subject areas:

- General observations/awareness of rumble strips
- Reaction to rumble strips as a motorist (e.g., visibility of rumble strips at night and during inclement weather, perceived safety and effectiveness)
- Location of home/residence

² This means that you can be 95 percent certain that the reported observation is within 3.5 percentage points of what it would have been if the *entire* population had been surveyed. For example, if a response rate is 65 percent, you can be 95 percent confident that the “true” population value is between 61.5 percent and 68.5 percent. While interesting differences among subgroups (e.g., age, gender, county) are discussed in this report, it is important to note that these differences may not be statistically significant.

- Quality of life
- Background information (e.g., age, employment status)

Geographic Distribution of Respondents

The survey response pattern was relatively uniform across all of the radii: less than 0.5 mile, 21 percent (314); 0.5 to 1.0 mile, 26 percent (399); 1.0 to 1.5 miles, 27 percent (412); and 1.5 to 2.0 miles, 26 percent (404).

Focus Groups

Two-person teams from PSC conducted seven focus group sessions, one facilitated dialogue and asked questions and the other served as a recorder. Interviews were conducted between December 7, 2005, and January 15, 2006. Participants were asked a series of questions focusing on the following themes:

- General observations/awareness of rumble strips
- Reaction to rumble strips as a frequent user of the freeway
- Perceived safety and effectiveness

SURVEY RESULTS

General Observations/Awareness of Rumble Strips

The first set of survey questions sought to determine the respondents' level of awareness of rumble strips on Michigan freeways. The respondents, by a large margin, are aware of rumble strips and have a positive opinion of them. Ninety-seven percent of those surveyed are aware of the purpose of the rumble strips, and 84 percent think they are a very good idea.

Question 1: Prior to reading the definition above, did you know the purpose of shoulder rumble strips?

	Number	Percentage
Yes	1,343	97.3%
No	25	1.8
Don't know/unsure	12	0.9
Total	1,380	100.0%
Missing	23	

SOURCE: Public Sector Consultants Inc.

Question 2: In general, do you think that putting shoulder rumble strips on highways and interstates is a very good idea, somewhat good idea, somewhat bad idea, or very bad idea?

	Number	Percentage
Very good idea	1,159	83.7%
Somewhat good idea	196	14.2
Somewhat bad idea	16	1.2
Very bad idea	10	0.7
Don't know	3	0.2
Total	1,384	100.0%
Missing	19	

SOURCE: Public Sector Consultants Inc.

Motorist Reaction to Rumble Strips

Several questions were asked to better understand motorists' reactions to rumble strips in a variety of weather conditions, including reactions to the three experimental rumble strip patterns in the Grand Rapids region.

Question 3: Think about the freeways in your general area—that is, all of the state highways (such as M-52) and federal interstates (such as I-96). As you travel on these roads, have you ever seen, heard, or felt rumble strips on the road edge or shoulder?

	Number	Percentage
Yes	1,303	94.3%
No	31	2.2
Don't know/can't remember	48	3.5
Total	1,382	100.0%
Missing	21	

SOURCE: Public Sector Consultants Inc.

A large majority of motorists (94 percent) have seen, heard, or felt rumble strips on the road edge.

Question 4: Have you ever seen the following types of painted rumble strips?

	Yes		No		Don't know		Total		Missing
	#	%	#	%	#	%	#	%	
Picture 1	768	58.1%	176	13.3%	377	28.5%	1,321	100.0%	82
Picture 2	754	60.2	149	11.9	350	27.9	1,253	100.0	150
Picture 3	281	22.6	445	35.9	515	41.5	1,241	100.0	162

SOURCE: Public Sector Consultants Inc.

The survey contained photographs of three different styles of painted rumble strips. Respondents are able to identify the first and second images at rates of 58 percent and 60 percent, respectively. Less than a quarter of the respondents (23 percent) can identify the third style of marking. (Responses to this question are necessarily affected by the distribution of the rumble strip markings on the roads that respondents regularly use.)

Younger motorists (aged 18 to 54) have higher recognition rates for marking styles 1 and 2 (64 percent and 66 percent, respectively) than respondents aged 55 to 75 (53 percent and 55 percent, respectively).

People residing in Montcalm and Ionia Counties have higher recognition rates (about two-thirds of respondents) for marking styles 1 and 2 than do residents of other counties. Women generally have lower recognition rates for these two styles (52 percent and 54 percent, respectively) than men (62 percent and 64 percent, respectively).

Question 5: Have you ever seen one of these patterns at night in the rain?

	Yes		No		Don't know		Total		Missing
	#	%	#	%	#	%	#	%	
Picture 1	520	41.7%	255	20.4%	472	37.9%	1,247	100.0%	156
Picture 2	465	39.2	241	20.3	480	40.5	1,186	100.0	217
Picture 3	165	14.3	415	36.0	573	49.7	1,153	100.0	250

SOURCE: Public Sector Consultants Inc.

Similar to responses to question 4, the first and second patterns are more readily identified by the respondents than the third at night and in the rain, but at lower rates, 42 percent and 39 percent, respectively. The third type of rumble strip marking is least recognized (14 percent). A significant proportion of respondents—about one-third to one-half, depending on the style of marking—are unsure whether they have seen any of the patterns at night in the rain.

At night and in the rain, younger people (aged 18 to 54) again have better recognition rates (44 percent for the pattern in picture 2) than older people (a recognition rate of 35 percent for respondents aged 55 to 75 and older). Respondents in Montcalm County have the best recognition rate for the patterns shown in pictures 1 and 2 (63 percent and 55 percent, respectively) at night and in the rain; respondents residing in Muskegon County have the lowest recognition rate in these conditions for the pattern shown in picture 1 (33 percent). At night and in the rain, women are again less likely than men to recognize the patterns in pictures 1 (34 percent vs. 46 percent, respectively) and 2 (31 percent vs. 44 percent, respectively).

Question 6a: Was the visibility of the line in the rumble strip enhanced in comparison to the edge line on the road?

	Yes		No		Don't know		Total		Missing
	#	%	#	%	#	%	#	%	
Picture 1	286	37.3%	138	18.0%	343	44.7%	767	100.0%	636
Picture 2	241	33.6	149	20.8	327	45.6	717	100.0	686
Picture 3	124	17.9	116	16.8	451	65.3	691	100.0	712

SOURCE: Public Sector Consultants Inc.

About one-third of respondents think that the types of rumble strip marking in the first and second images have greater visibility than the edge line on the road, more so than the dashed line in picture 3 (18 percent). For each marking pattern, however, a plurality of the respondents (and in the case of the third style of marking, nearly two-thirds of respondents) cannot determine whether the rumble strip marking has enhanced visibility compared to the edge line of the road.

More than 43 percent of respondents aged 25 to 34 think that the visibility of the line in the rumble strip is enhanced compared to the edge line for the styles in pictures 1 and 2. This percentage decreases markedly for respondents aged 75 and older (27 percent and 18 percent for the patterns in pictures 1 and 2, respectively).

Question 6b: If you knew that a paint line placed on a rumble strip enhanced the visibility of the paint line at night in the rain, which of the three paint patterns would you prefer to see used on Michigan's roadways?

	Number	Percentage
Picture 1	525	41.3%
Picture 2	309	24.3
Picture 3	436	34.3
Total	1,270	100.0%
Missing	133	

SOURCE: Public Sector Consultants Inc.

NOTE: Percentages in response rates may not = 100 due to rounding.

Overall, the highest preference is for the pattern in picture 1 (41 percent) followed by the pattern in picture 3 (34 percent) and the style in picture 2 (24 percent). This same ranking holds regardless of county of residence, distance of residence from the highway or interstate, or gender. In contrast, 64 percent of younger respondents (aged 18 to 24) favor the marking style in picture 3, while respondents aged 45 to 54 rank the patterns in pictures 1 and 3 about the same (approximately 38 percent).

It is noteworthy that many respondents prefer the pattern in picture 3 even though that marking style has the lowest recognition rates.

Question 7: Which of the following best describe the benefits that you believe the painted shoulder rumble strips add to Michigan roads?

	Number	Percentage
Improve the visibility of the road at night	994	70.8%
Provide warning to drowsy drivers	1,133	80.8
Alert inattentive drivers who stray off the highway surface	1,119	79.8
Improve a driver's ability to see the road edge when conditions reduce visibility (such as during rain or snow)	935	66.6
Total	1,403	

SOURCE: Public Sector Consultants Inc.

No matter which pattern of marking they prefer, respondents are positive about the benefits of the painted shoulder rumble strips. Four out of five respondents think that painted rumble strips increase the vigilance of drowsy or inattentive motorists (81 percent and 80 percent, respectively). About 71 of respondents think that painted rumble strips improve the visibility of the road at night. Nearly two-thirds believe that painted rumble strips improve motorists' ability to see the road edge visibility deteriorates during rain and snow.

Those aged 25 to 44 are least likely to acknowledge the visibility benefits of painted rumble strips: only 61 percent think the painted rumble strips improve the visibility of the road at night (item [a] above) and 57 percent think they help the driver see the road edge when visibility is limited (item [d]). Residents of Ionia County are also less likely than residents of other counties to note these visibility benefits, with 65 percent and 58 percent selecting items [a] and [d], respectively.

Question 8: Please mark whether you agree or disagree with each of the following statements.

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Don't know	Total	Missing
I use the interstate to get to work and am largely unaware of the rumble strips.	9.1%	7.0%	21.8%	7.9%	46.9%	7.4%	1,259	144
I was drowsy and hit the rumble strips and they alerted me.	42.1	21.1	15.1	3.3	14.3	4.1	1,305	98
The rumble strips have warned me when I was distracted on the interstate highway.	60.0	24.2	6.6	2.9	4.5	1.9	1,332	71
I feel safer using the interstate because of the rumble strips.	47.9	29.4	16.1	2.2	2.9	1.5	1,316	87

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	Don't know	Total	Missing
I don't like the rumble strips because of the noise made when I drive over them.	2.2	4.2	7.9	11.1	72.9	1.6	1,303	100
The rumble strips are unimportant.	2.9	1.5	3.1	9.8	81.5	1.2	1,311	92

SOURCE: Public Sector Consultants Inc.

Most survey respondents are very positive about the painted rumble strips. About 84 percent “strongly” or “somewhat” agree that the rumble strips warn them when they are distracted while driving, and 77 percent feel safer because of the rumble strips. Sixty-three percent “strongly” or “somewhat” agree that the rumble strips alert them when they are drowsy. By a large majority (82 percent), survey respondents “strongly” disagree with the statement that rumble strips are unimportant. Nearly three-quarters of respondents (73 percent) “strongly” disagree with the statement, “I don’t like the rumble strips because of the noise made when I drive over them.” Nearly half of the respondents (47 percent) strongly disagree with the statement, “I use the interstate to get to work and am largely unaware of the rumble strips.”

Respondents younger than age 55 are more likely to be aware of the rumble strips than those over the age of 55 (60 percent compared to 50 percent, respectively). This may be because a larger proportion of the younger respondents are in the work force. Eighty-two percent of those over age 55 “strongly” or “somewhat” agree that they feel safer because of the rumble strips, compared to 71 percent of those under the age of 55.

Residents of Mecosta and Oceana Counties are more likely than residents of other counties to “strongly” agree that the rumble strips alert them when they are drowsy (55 percent and 53 percent, respectively) or distracted (67 percent and 71 percent, respectively).

Question 9: Based on the paint patterns shown on page 2 and your understanding of Michigan traffic law, is the use of the shoulder legal or illegal?

	Legal		Illegal		Don't know		Total		Missing
	#	%	#	%	#	%	#	%	
Picture 1	608	47.2%	289	22.4%	392	30.4%	1,289	100.0%	114
Picture 2	557	44.6	299	24.0	392	31.4	1,248	100.0	155
Picture 3	527	42.5	262	21.1	452	36.4	1,241	100.0	162

SOURCE: Public Sector Consultants Inc.

A plurality of respondents (43 percent or more) believes that use of shoulders as depicted in all three of the pictures is legal, even the double solid line. Only 24 percent or less believe such use is illegal.

Residents of Muskegon and Ionia Counties are least likely to consider the rumble strip pattern shown in picture 2 legal (38 percent and 36 percent, respectively). Residents of Ottawa County are most likely to consider the shoulder use in picture 3 legal (49 percent). Respondents aged 65 and older are the most unsure of the legality of using the shoulder for painted rumble strips (38 percent, 41 percent, and 46 percent for the styles shown in pictures 1, 2, and 3, respectively).

Location of Home/Residence

Question 10: From your home (that is, at the address where you received this survey), can you hear any noise from the nearest highway or interstate?

	Number	Percentage
Yes	719	52.7%
No	639	46.8%
Don't know	6	0.4%
Total	1,364	100.0%
Missing	39	

SOURCE: Public Sector Consultants Inc.

NOTE: Percentages in response rates may not = 100 due to rounding.

Most respondents (53 percent) can hear noise from the nearest highway or interstate. Eighty-three percent of residents living 0.5 miles or less from the highway report hearing noise. This percentage declines to 30 percent for residents living 1.5 to 2.0 miles from the interstate or highway.

Question 11: In general, how loud is the noise from the nearest highway or interstate? Use a 1 to 5 scale, with "1" being *a little noise* and "5" being *very loud and intrusive*.

	Number	Percentage
Little noise 1	308	42.7%
2	168	23.3
3	147	20.4
4	63	8.7
Very loud and intrusive 5	36	5.0
Total	722	100.0%
Missing	681	

SOURCE: Public Sector Consultants Inc.

NOTE: Percentages in response rates may not = 100 due to rounding.

Using this scale, 66 percent of respondents rate the highway or interstate noise as relatively low, with a score of 1 or 2. More than half of residents living 0.5 miles or less from the highway (51 percent) rated the noise at 1 or 2. This percentage increases to 81 percent for residents living 1.5 to 2.0 miles from the interstate or highway.

Respondents over the age of 75 are least likely to find the noise level annoying (80 percent rate it 1 or 2), followed by those aged 25 to 34 and 65 to 74 (60 percent in each group rate the noise level 1 or 2). Among the geographical areas surveyed, residents of Ionia County give the lowest noise ratings (58 percent rate the noise level 1 or 2).

Question 12: In general, how often do you hear the noise from the nearest highway or interstate? Use a 1 to 5 scale, with "1" being *very rarely* and "5" being *almost constant*.

	Number	Percentage
Very rarely 1	173	23.9%
2	222	30.6
3	171	23.6
4	95	13.1
Almost constant 5	64	8.8
Total	725	100.0%
Missing	678	

SOURCE: Public Sector Consultants Inc.

About 55 percent of respondents report hearing highway or interstate noise infrequently (a score of 1 or 2). This percentage drops to 42 percent for residents living 0.5 miles or less from the highway or interstate and increases to 65 percent for respondents living 1.5 to 2.0 miles from the interstate or highway.

Younger respondents (aged 35 to 44) appear to hear highway noise more often (only 45 percent of these respondents rate the frequency a 1 or 2). In contrast, more than two-thirds of respondents over the age of 75 (69 percent) rate the frequency of noise 1 or 2. Despite the general perception of relative quiet, nearly a third of Ionia County respondents (32 percent) give the highest ratings (4 or 5) for the frequency of hearing highway noise.

Question 13: In general, what types of noises do you hear from the nearest highway or interstate? Do you hear...

	Number	Percentage
Truck engines	46	22.2%
General traffic sounds	122	58.9
Horns		0.0
Road noise from tires	28	13.5
Rumble strips	10	4.8
Accelerating/slowing traffic	1	0.5
Total	207	100.0%
Missing	1,196	

SOURCE: Public Sector Consultants Inc.

NOTE: Percentages in response rates may not = 100 due to rounding.

Most respondents do not identify a specific sound from the freeway or interstate. Among those who do identify specific noises, general traffic sounds are the most common (59 percent). Sixty-nine percent of respondents living 0.5 to 1.0 miles report these noises. Kent County has the highest proportion of respondents reporting hearing general traffic sounds (68 percent). Among the various age groups, 71 percent of respondents aged 75 or older reported hearing general traffic noise, compared to 48 percent of respondents aged 45 to 54.

It is noteworthy that only 4.8 percent of respondents who identify specific noises report hearing rumble strip noise.

Question 14: At what times of day do you most frequently hear noise from the nearest highway or interstate?

	Number	Percentage
Monday – Friday before 8:00 AM	79	20.8%
Monday – Friday 8:00 AM – 12:00 PM	41	10.8
Monday – Friday 12:00 PM – 5:00 PM	34	9.0
Monday – Friday 5:00 PM – 12:00 AM	148	39.1
On weekends	77	20.3
Total	379	100.0%
Missing	1,024	

SOURCE: Public Sector Consultants Inc.

Most respondents do not identify a specific time of day when they hear highway noise. Among those who do notice a specific time, 59 percent note weekdays from 5:00 PM to 12:00 AM and weekends. Those aged 25 to 44 are most likely to identify these time periods (78 percent), while respondents aged 65 years and older identify these time periods at a lower rate (44 percent).

Question 15: Where in or near your house are you most aware of the noise?

	Number	Percentage
Working outside in the yard	544	87.2%
Indoors	78	12.5
In your car	2	0.3
Total	624	100.0%
Missing	779	

SOURCE: Public Sector Consultants Inc.

Almost 9 out of 10 persons surveyed (87 percent) are most aware of highway noise while working in the yard. For persons aged 75 and older, this rate drops to 78 percent.

Question 16: In a normal week, what are the most typical time periods that you are at home?

	Number	Percentage
Monday – Friday before 8:00 AM	27	13.4%
Monday – Friday 8:00 AM – 12:00 PM	33	16.3
Monday – Friday 12:00 PM – 5:00 PM	13	6.4
Monday – Friday 5:00 PM – 12:00 AM	101	50.0
On weekends	28	13.9
Total	202	100.0%
Missing	1,201	

SOURCE: Public Sector Consultants Inc.

The most common time for people to be at home is weekdays from 5:00 PM to 12:00 AM and weekends (a total of 64 percent). For respondents aged 18 to 54 this rate increases to 78 percent. Respondents aged 65 and older are most likely to be home before 8:00 AM and from 8:00 AM to 12:00 PM (47 percent).

Question 17: In the past year, do you think the level of noise from the nearest highway or interstate has...

	Number	Percentage
Increased dramatically	48	6.6%
Increased some	197	27.2
Stayed about the same	440	60.8
Decreased some	13	1.8
Decreased dramatically	0	0.0
Don't know	26	3.6
Total	724	100.0%
Missing	679	

SOURCE: Public Sector Consultants Inc.

Most people (61 percent) say that the noise level has stayed the same over the past year. The next largest group of respondents (27 percent) says the noise level has increased some. Respondents from Oceana and Ottawa Counties report the highest rates for “stayed about the same” (68 percent and 77 percent, respectively).

Quality of Life

Question 18: Has the noise from *rumble strips* ever caused you to ...

	Yes		No		Don't know		Total		Missing
	#	%	#	%	#	%	#	%	
Close the windows in your home to limit the noise?	47	6.6%	650	91.0%	17	2.4%	714	100.0%	689
Spend less time doing out-door activities (e.g. yard maintenance, sports, etc)?	13	1.9	678	96.9	9	1.3	700	100.0	703
Write a letter to or call MDOT or a government official?	7	1.0	680	98.1	6	0.9	693	100.0	710

SOURCE: Public Sector Consultants Inc.

The level of noise from the rumble strips has minimal impact on the large majority of respondents. Ninety-one percent do not feel the need to close windows to limit the noise from rumble strips. Only a few spend less time outside or have written a letter of complaint to MDOT because of rumble strip noise (1.9 percent and 1.0 percent, respectively).

Twelve percent of those living 0.5 miles from the highway report closing the window to limit noise from rumble strips, compared to 7 percent of all respondents. No one living more than 1.5 miles from the highway reports this as an issue. Residents of Ionia, Mecosta, and Muskegon Counties are more likely than respondents from other counties to report closing the windows because of rumble strip noise (15 percent, 13 percent, and 12 percent, respectively).

Question 19: Has the noise from *the nearest highway or interstate* caused you to ...

	Yes		No		Don't know		Total		Missing
	#	%	#	%	#	%	#	%	
Close the windows in your home to limit the noise?	132	18.6%	572	80.8%	4	0.6%	708	100.0%	695
Spend less time doing out-door activities (e.g. yard maintenance, sports, etc)?	28	4.0	668	95.4	4	0.6	700	100.0	703
Write a letter to or call MDOT or a government official?	4	0.6	681	99.1	2	0.3	687	100.0	716

SOURCE: Public Sector Consultants Inc.

Like rumble strip noise in particular, the overall level of noise from the nearest highway or interstate has minimal impact on the large majority of respondents. Four out of five (81 percent) do not feel the need to close windows to limit the noise from the highways. Only a few (4.0 percent and 0.6 percent, respectively) spend less time outside or have written a letter of complaint to MDOT because of highway noise.

One-fourth of respondents who live within 0.5 miles of the highway or interstate report closing a window to limit highway noise, compared to 19 percent of all respondents. This percentage declines to 9 percent for respondents living 1.5 to 2.0 miles from the highway or interstate. Respondents in Ionia County report the highest rate of closing a window to limit highway noise (25 percent), while respondents living in Montcalm, Oceana, and Ottawa Counties report the lowest rates for closing a window to block noise (less than 9 percent).

Question 20: Throughout the year, are you more aware of the noise from *rumble strips* in the...

	Number	Percentage
Spring	5	0.8%
Summer	145	23.9
Fall	2	0.3
Winter	8	1.3
No difference	326	53.7
Don't know	121	19.9
Total	607	100.0%
Missing	796	

SOURCE: Public Sector Consultants Inc.

NOTE: Percentages in response rates may not = 100 due to rounding.

More than half of the survey respondents do not notice a difference in the noise from rumble strips throughout the year and another 20 percent do not know if there is a seasonal difference. About one-fourth of respondents (24 percent) are more aware of the noise in the summer. Residents in Mecosta, Muskegon, and Oceana Counties have the highest rates of increased awareness of rumble strip noise in the summer (38 percent, 33 percent, and 38 percent, respectively).

Question 21: Throughout the year, are you more aware of the noise from *the nearest highway or interstate* in the ...

	Number	Percentage
Spring	13	2.4%
Summer	254	46.4
Fall	6	1.1
Winter	27	4.9
No difference	212	38.7
Don't know	36	6.6
Total	548	100.0%
Missing	855	

SOURCE: Public Sector Consultants Inc.

NOTE: Percentages in response rates may not = 100 due to rounding.

More respondents notice seasonal differences in general highway noise than for rumble strip noise. Forty-six percent of respondents are more aware of noise from the nearest highway or interstate in summer. The next largest group (39 percent) detects no difference throughout the year. Respondents aged 35 to 44 are least likely to notice an increase in highway noise in summer (36 percent), while more respondents aged 65 to 74 notice an increase in noise in the summer (55 percent). Residents of Mecosta County are more aware than residents of other counties of an increase of noise in the summer (62 percent), while residents of Ottawa County are the least aware of such a change (38 percent).

Question 22: Please read the following statements. *For each statement, mark whether you strongly agree, somewhat agree, somewhat disagree, or strongly disagree.*

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree	Total	Missing
The noise from rumble strips makes me want to move further away from the highway/interstate	3.0%	8.1%	19.3%	69.6%	700	703
The general noise from the highway/interstate makes me want to move farther away from the highway/interstate	5.4	18.7	18.2	57.7	705	698
Shoulder rumble strips make me feel safer when traveling on the highway	58.8	32.2	5.6	3.4	711	692
Shoulder rumble strips help me to drive more carefully	40.7	39.9	11.6	7.9	700	703
Don't know	3.0	7.3	8.5	81.1	164	1,239

SOURCE: Public Sector Consultants Inc.

The majority of respondents (59 percent) “strongly” agree that rumble strips make them feel safer driving, and 41 percent “strongly” agree that the rumble strips promote more careful driving.

A large majority of respondents “strongly” or “somewhat” disagree that the noise of rumble strips or that the general highway noise makes them want to move farther away from the highway/interstate (89 percent and 76 percent, respectively). This proportion rises to 95 percent for respondents aged 75 and older.

Fewer respondents aged 18 to 54 (51 percent) than all respondents “strongly” agree that the rumble strips makes them feel safer when traveling on the interstate or highway, and a larger percentage of respondents aged 65 and older (65 percent) “strongly” agree with this statement. Similarly, fewer younger respondents (aged 18 to 54) than respondents overall “strongly” agree that shoulder rumble strips help them drive more carefully (34 percent), compared to 47 percent of older respondents (aged 65 and older).

Residents of Ionia County “strongly” agree less than residents of other counties (46 percent) that rumble strips make them feel safer when traveling on the highway; while residents of Mecosta County have a higher rate of agreement with this statement (73 percent). More than 46 percent of residents of Mecosta and Oceana Counties “strongly” agree with the statement that rumble strips help them to drive more carefully, compared to only 30 percent and 31 percent, respectively, of Ionia and Montcalm County residents.

About 70 percent of respondents who live more than 1.5 miles from the highway or interstate “strongly” agree with the statement that rumble strips make them feel safer when traveling on the highway. This proportion drops to 50 percent for respondents who live 0.5 to 1.0 miles from the highway.

Question 23: In general, when you think about your experience traveling on roads that have shoulder rumble strips, which statement comes closest to your reaction?

	Number	Percentage
I am pleased with them	304	25.3%
I want them removed	22	1.8
They add to the safety of highways	813	67.7
No comment/unsure/I haven't thought about them	62	5.2
Total	1,201	100.0%
Missing	202	

SOURCE: Public Sector Consultants Inc.

Most respondents (68 percent) feel that rumble strips add to the safety of the highways. One-fourth of respondents say they are pleased with rumble strips. Residents of Oceana County report a highest rate among the counties of satisfaction with rumble strips (41 percent).

FOCUS GROUP RESULTS

In addition to surveying residents who live in close proximity to the designated rumble strip areas, the project gathered information from drivers that travel the identified freeway segments with high frequency. A total of 33 drivers representing five different companies and two law enforcement agencies participated in the focus group discussions between December 7, 2005, and January 15, 2006.

General Observations/Awareness of Rumble Strips

Most drivers admit to making contact with rumble strips at one time or another in their driving career. Drivers who participated in the focus groups are universally aware and supportive of painted rumble strips as valuable safety measures on Michigan freeways, although a majority of them have difficulty distinguishing between the three experimental patterns. This could be a result of the limited geographic area in which the experimental rumble strips were evaluated. But there does appear to be a greater consensus that the pattern in picture 1, with two painted lines, is more visible than a single painted line in the rumble strip (picture 2). In fact, the marking with two painted lines is preferred by the law enforcement personnel that participated in the study.

Many drivers believe that reflective tape (vinyl or other material) installed as an edge line would be much more visible than painted lines, which have a tendency to fade more quickly. Because drivers focus on the visibility of painted edge lines and “aim high” for lane orientation first and foremost, they recommend that MDOT allocate more resources to ensure that edge and centerlines are painted on a more frequent basis to enhance overall visibility and safety. Generally, the drivers do not notice a benefit from painted rumble strips when driving at night and in times of low visibility. However, simply knowing that the painted rumble strips are prevalent appears to offer a greater feeling of security.

Reaction to Rumble Strips as a Frequent User of the Freeway

The drivers generally agree that painted rumble strips raise driving awareness and reduce the frequency of accidents. The benefits of painted rumble strips that focus group participants mentioned most often are that they

- provide warning to drowsy drivers and
- alert inattentive drivers who stray off the freeway surface.

Some law enforcement personnel, specifically county police who use motorcycle patrols on the freeways, indicate that rumble strips can create hazardous conditions for motorcyclists due to the vibration and potential to lose steering control. In addition, the largest complaint from truck drivers is that in some construction zones where the road shoulder is utilized as a driving lane, they are forced to drive on rumble strips for long distances.

Perceived Safety and Effectiveness

There is unanimous agreement that painted rumble strips enhance overall freeway safety. However, there is some disagreement as to the most effective placement of the painted rumble strip in proximity to the edge line. While opinions varied, the consensus that

emerged suggests that an optimum placement distance of 8–14 inches from the edge line would be most effective. Placement of the rumble strip contiguous to or less than 8 inches from the edge line increases the incidence of tire contact with rumble strips; since automobile drivers have a tendency to overcorrect their steering and cross the centerline this can create unsafe conditions. In addition, some drivers think that the close proximity of a rumble strip to an edge line results in quicker degradation of the road surface because contact (and vibration) with rumble strips occurs at a greater frequency.

While it was difficult to ascertain whether the noise generated by tire vibration or actual steering wheel vibration is the most salient feature of rumble strips for grabbing driver attention, it appears that the noise created is the most distinguishable characteristic when a driver makes contact with a rumble strip.

There is unanimous agreement that rumble strips are invaluable when roads become snow covered and edge lines are no longer visible. The rumble strips provide an important safety feature and allow drivers to more safely navigate the freeway.

Summary and Conclusions

This study surveyed 10,000 households within a two-mile range of a Michigan freeway and included seven focus group meetings with commercial truck drivers and law enforcement personnel to determine the perceived differences among three types of experimental painted rumble strip patterns. Results show that rumble strips are overwhelmingly accepted and supported by a large majority of Michigan drivers, with a preference for a rumble strip marking that contains two painted (solid) stripes.

Generally, motorists are aware only of two of the three types of experimental painted rumble strip patterns; the first is an edge line on the road with a parallel line in the rumble strip; the second is a single line in the rumble strip. Only about 23 percent of respondents recognize the third type, an edge line on the road and a parallel dashed line in the rumble strip, with another 41 percent uncertain whether they have seen this pattern. Interestingly, while only 23 percent of respondents are able to recognize the third pattern type, it ranks second highest (33 percent) when respondents chose the type they would prefer to see on Michigan freeways.

When asked if they have ever seen the three different rumble strip patterns at night in the rain, a significant proportion of respondents—about one-third to one-half, depending on the style of marking—are unsure whether they have seen any of the patterns.

In addition, while the focus of the study was painted rumble strips, it is apparent that most respondents are more aware of the noise and vibration caused by rumble strips than of any painted patterns in the strips.

Many study participants felt obliged to offer additional recommendations to improve overall freeway safety. Recurring themes are the need for MDOT to keep fresh paint on center and edge lines; increase the use of freeway signage; and consider the use of public service announcements to inform the driving public. In addition, participants in this study were very supportive of MDOT efforts to evaluate painted rumble strips and were generally eager to offer feedback.

Shoulder rumble strips are a proven roadside treatment in preventing run-off-the-road crashes on freeways. The noise and vibration produced by shoulder rumble strips are effective alarms for drowsy or distracted drivers who are leaving the roadway. The rumble strips are also helpful in areas where motorists lose visibility of the edge line in fog and snow. By painting the shoulder rumble strips, the MDOT is trying to enhance their effectiveness. Research has shown that painted rumble strips are visible at night in the rain, making them an additional safety feature for drivers navigating Michigan's freeways.

Appendix

Survey Response Frequencies and Instrument

MDOT RUMBLE STRIP SURVEY: RESIDENTS

Introduction

Between 2003 and 2005, the Michigan Department of Transportation (MDOT) installed painted rumble strips and pavement markings on approximately 160 miles of freeway in the greater Grand Rapids area.

A rumble strip is a length of indented pavement parallel to the direction of travel that causes your car's tires to vibrate as a warning that you are leaving the road.

Approximately half of these rumble strips were installed according to existing MDOT guidelines, while the other half were installed using a variation in the location of the rumble strip and painted edge lines.

An edge line is a solid painted line, between 4 and 6 inches wide, that runs parallel to the direction of vehicle travel that separates a driving lane from the shoulder. Edge lines on the right-hand side of the travel direction are white; edge lines on the left side of the travel direction are yellow.

MDOT is interested in your perceptions of these painted shoulder rumble strips, both as a user of roads in the area as well as a homeowner near these roads.

General Observations/Awareness of Rumble Strips

1. Prior to reading the definition above, did you know the purpose of shoulder rumble strips?

Yes	97.3%
No	1.8
Don't know/unsure	0.9

2. In general, do you think that putting shoulder rumble strips on highways and interstates is a very good idea, somewhat good idea, somewhat bad idea, or very bad idea?

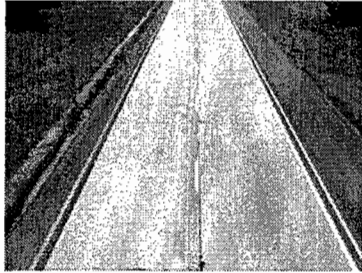
Very good idea	83.7%
Somewhat good idea	14.2
Somewhat bad idea	1.2
Very bad idea	0.7
Don't know	0.2

NOTE: Responses may not equal 100% due to rounding.

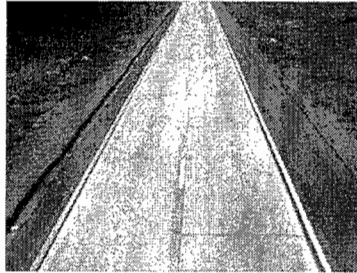
Reaction to rumble strips as a motorist

3. Think about the freeways in your general area—that is, all of the state highways (such as M-52) and federal interstates (such as I-96). As you travel on these roads, have you ever seen, heard, or felt rumble strips on the road edge or shoulder?

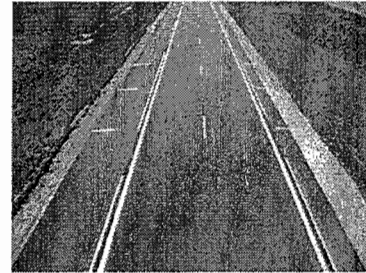
Yes (Go to question 4)	94.3%	} Skip to question 7
No	2.2	
Don't know/cannot remember	3.5	



Picture 1



Picture 2



Picture 3

4. Have you ever seen the following types of painted rumble strips? (See images above.)

	Yes	No	Don't know
Picture 1	58.1%	13.3%	28.5%
Picture 2	60.2	11.6	27.9
Picture 3	22.6	35.9	41.5

If you answered "No" or "Don't know" to *all three*, skip to question 6b.

5. Have you ever seen one of these patterns at night in the rain?

	Yes	No	Don't know
Picture 1	41.7%	20.4%	37.9%
Picture 2	39.2	20.3	40.5
Picture 3	14.3	36.0	49.7

- 6a. Was the visibility of the line in the rumble strip enhanced in comparison to the edge line painted on the road?

	Yes	No	Don't know
Picture 1	37.3%	18.0%	44.7%
Picture 2	33.6	20.8	45.6
Picture 3	17.9	16.8	65.3

- 6b. If you knew that a paint line placed on a rumble strip enhanced the visibility of the paint line at night in the rain, which of the three paint patterns would you prefer to see used on Michigan's roadways?

Picture 1	41.3%
Picture 2	24.3
Picture 3	34.3

7. Which of the following best describe the benefits that you believe the shoulder rumble strips add to Michigan roads? (Mark **all** that apply.)

Improve the visibility of the road at night	70.8%
Provide warning to drowsy drivers	80.8
Alert inattentive drivers who stray off the highway surface	79.8
Improve a driver's ability to see the road edge when conditions reduce visibility (such as during rain or snow)	66.6
Other: (open response)	

8. Please mark whether you agree or disagree with each of the following statements.

	Strongly agree	Somewhat agree	Neutral/no opinion	Somewhat disagree	Strongly disagree	Don't know
I use the interstate to get to work and am largely unaware of the rumble strips.	9.1%	7.0%	21.8%	7.9%	46.9%	7.4%
I was drowsy and hit the rumble strips and they alerted me.	42.1	21.1	15.1	3.3	14.3	4.1
The rumble strips have warned me when I was distracted on the interstate highway.	60.0	24.2	6.6	2.9	4.5	1.9
I feel safer using the interstate because of the rumble strips.	47.9	29.4	16.1	2.2	2.9	1.5
I don't like the rumble strips because of the noise made when I drive over them.	2.2	4.2	7.9	11.1	72.9	1.6
The rumble strips are unimportant.	2.9	1.5	3.1	9.8	81.5	1.2

9. Based on the paint patterns shown on page 2 and your understanding of Michigan traffic law, is the use of the shoulder legal or illegal?

	Use of the shoulder is?		
	Legal	Illegal	Don't know
Picture 1	47.2%	22.4%	30.4%
Picture 2	44.6	24.0	31.4
Picture 3	42.5	21.1	36.4

Location of Home/Residence

10. From your home (that is, at the address where you received this survey), can you hear any noise from the nearest highway or interstate?

Yes	52.7%	} Skip to question 23.
No	46.8	
Don't know	0.4	

11. In general, how loud is the noise from the nearest highway or interstate? Use a 1 to 5 scale, with "1" being a little noise and "5" being very loud and intrusive.

1	2	3	4	5
46.9%	21.4%	18.7%	7.9%	5.1%

12. In general, how often do you hear the noise from the nearest highway or interstate? Use a 1 to 5 scale, with "1" being very rarely and "5" being almost constant.

1	2	3	4	5
30.2%	28.0%	21.7%	12.0%	8.1%

13. In general, what types of noises do you hear from the nearest highway or interstate? Do you hear ...

Truck engines	23.3%
General traffic sounds	58.0
Horns	1.6
Radios	0.0
Road noise from tires	12.2
Rumble strips	4.5
Accelerating/slowing traffic	0.4
Other (open response)	

14. At what times of day do you most frequently hear noise from the nearest highway or interstate?

Monday through Friday before 8:00 a.m.	21.2%
Monday through Friday 8:00 a.m.–12:00 p.m.	11.7
Monday through Friday 12:00 p.m.–5:00 p.m.	8.6
Monday through Friday 5:00 p.m.–12:00 a.m.	38.7
On weekends	19.8

15. Where in or near your house are you most aware of the noise?

Working outside in the yard	86.0%
Indoors	12.0
In your car	2.0
Other (open response)	

16. In a normal week, what are the most typical time periods that you are at home?

Monday through Friday before 8:00 a.m.	13.1%
Monday through Friday 8:00 a.m.–12:00 p.m.	16.4
Monday through Friday 12:00 p.m.–5:00 p.m.	6.6
Monday through Friday 5:00 p.m.–12:00 a.m.	50.0
On weekends	13.9
Other: (open response)	

17. In the past year, do you think the level of noise from the nearest highway or interstate has ...

Increased dramatically	6.6%
Increased some	26.4
Stayed about the same	60.3
Decreased some	1.6
Decreased dramatically	0.0
Don't know	5.0

Quality of Life

18. Has the noise from **rumble strips** ever caused you to ...

	Yes	No	Don't know
Close the windows in your home to limit the noise?	6.2%	91.2%	2.6%
Spend less time doing outdoor activities (e.g., barbecuing, yard maintenance, sports, etc.)?	1.7	96.4	1.9
Write a letter to or call MDOT or a government official?	0.9	97.7	1.4

19. Has the noise from **the nearest highway or interstate** caused you to ...

	Yes	No	Don't know
Close the windows in your home to limit the noise?	17.4%	81.6%	1.0%
Spend less time doing outdoor activities (e.g., barbecuing, yard maintenance, sports, etc.)?	3.7	95.1	1.2
Write a letter to or call MDOT or a government official?	0.5	98.7	0.8

20. Throughout the year, are you more aware of the noise from **rumble strips** in the...

Spring	1.0%
Summer	23.0
Fall	0.7
Winter	1.2
No difference	54.7
Don't know	19.4

21. Throughout the year, are you more aware of the noise from **the nearest highway or interstate** in the ...

Spring	2.4%
Summer	44.5
Fall	1.6
Winter	5.0
No difference	39.5
Don't know	6.9

22. Please read the following statements. *For each, please mark whether you strongly agree, somewhat agree, somewhat disagree, or strongly disagree with the statement.*

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
The specific noise from the rumble strips makes me want to move farther away from the highway/interstate.	2.8%	7.8%	19.4%	70.1%
The general noise from the highway/interstate makes me want to move farther away from the highway/interstate.	5.2	18.2	18.2	58.4
Shoulder rumble strips make me feel safer when traveling on the highway.	60.1	31.3	5.10	3.5
Shoulder rumble strips help me to drive more carefully.	42.5	38.8	10.8	7.8
Don't know.	4.1	6.6	11.2	78.1

23. In general, when you think about your experience traveling on roads that have shoulder rumble strips, which statement comes closest to your reaction?

I am pleased with them.	25.3%
I want them removed.	1.8
They add to the safety of the highways.	67.7
No comment/unsure/I haven't thought much about them.	5.2

Background Information

The following information is collected for statistical purposes only.

24. Approximately how far is your residence from the nearest state highway or interstate, drawing a straight line?

Less than 1/4 mile	13.0%
1/4 to 1/2 mile	21.9
1/2 to 1 mile	33.9
More than 1 mile	30.2
Don't know/unsure	1.1

25. Which age category are you in?

18–24 years old	0.8%
25–34 years old	6.5
35–44 years old	14.9
45–54 years old	22.9
55–64 years old	25.1
65–74 years old	18.2
75 years old or older	11.5

26. What is your employment status? Are you ...

Employed outside the home full time	49.4%
Employed outside the home part time	8.7
Work at home or are retired	36.4
Other	5.5

27. Are you currently taking education or skill-building classes toward a degree?

Yes	4.9%
No	95.0
Don't know	0.1

28. Are there any children under the age of 18 living in your household?

Yes	27.0%
No	73.0
Don't know	0.1

29. What is the highest level of education you have completed?

Incomplete high school	4.0%
High school graduate/GED	19.7
Vocational/technical school or an associate's degree	10.6
Some college	20.7
College graduate	22.2
Postgraduate study or degree	20.9
Don't know	0.0
Prefer not to say	1.8

30. What is your gender?

Male	63.3%
Female	36.7

Thank you!

MDOT Painted Rumble Strip Survey

Residents

INTRODUCTION

Between 2003 and 2005, the Michigan Department of Transportation (MDOT) installed painted rumble strips and pavement markings on approximately 160 miles of freeway in the greater Grand Rapids area.

A rumble strip is a length of indented pavement parallel to the direction of travel that causes your car's tires to vibrate as a warning that you are leaving the road.

Approximately half of these rumble strips were installed according to existing MDOT guidelines, while the other half were installed using a variation in the location of the rumble strip and painted edge lines.

An edge line is a solid painted line, between 4 and 6 inches wide, that runs parallel to the direction of vehicle travel that separates a driving lane from the shoulder. Edge lines on the right-hand side of the travel direction are white; edge lines on the left side of the travel direction are yellow.

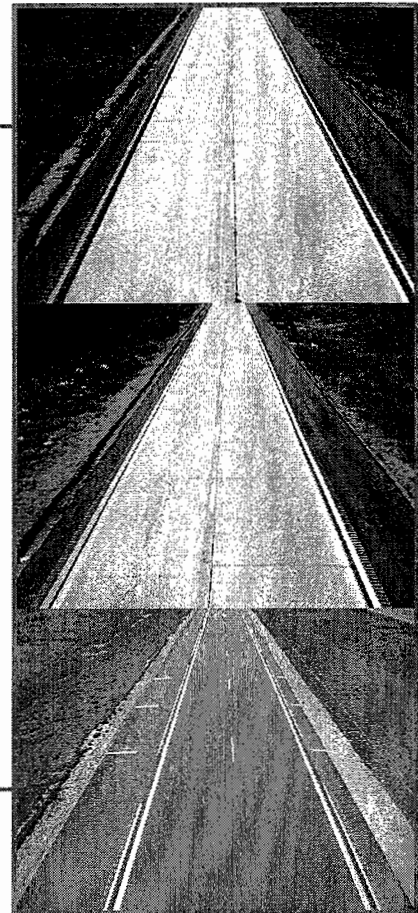
MDOT is interested in your perceptions of these painted shoulder rumble strips, both as a user of roads in the area as well as a homeowner near these roads.

MARKING INSTRUCTIONS

- Use a No. 2 pencil only.
- Do not use ink, ballpoint, or felt tip pens.
- Make solid marks that fill the response completely.
- Erase cleanly any marks you wish to change.
- Make no stray marks on this form.

CORRECT: ●

INCORRECT: ☑ ✗ ○ ●



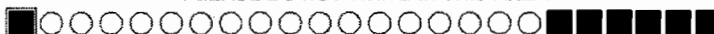
GENERAL OBSERVATIONS/AWARENESS OF RUMBLE STRIPS

1. Prior to reading the definition above, did you know the purpose of shoulder rumble strips?
 - a. Yes (Y)
 - b. No (N)
 - c. Don't know/unsure (?)
2. In general, do you think that putting shoulder rumble strips on highways and interstates is a very good idea, somewhat good idea, somewhat bad idea, or very bad idea?
 - a. Very good idea (A)
 - b. Somewhat good idea (B)
 - c. Somewhat bad idea (C)
 - d. Very bad idea (D)
 - e. Don't know (E)

REACTION TO RUMBLE STRIPS AS A MOTORIST

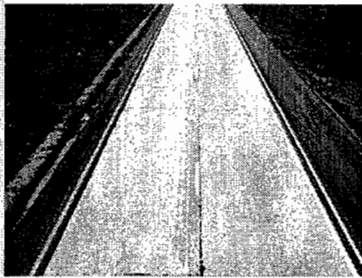
3. Think about the freeways in your general area—that is, all of the state highways (such as M-52) and federal interstates (such as I-96). As you travel on these roads, have you ever seen, heard, or felt rumble strips on the road edge or shoulder?
 - a. Yes (Y)
 - b. No (N)
 - c. Don't know/cannot remember (?)

PLEASE DO NOT WRITE IN THIS AREA



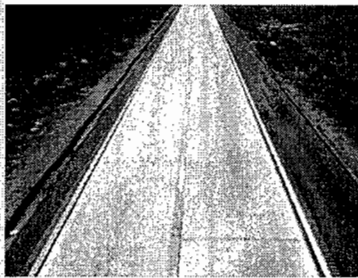
[SERIAL]

Picture 1



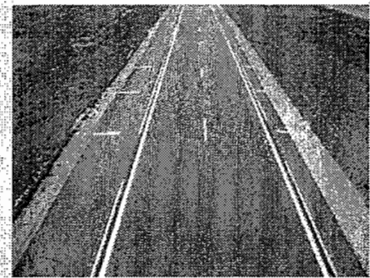
An edge line on the road, a parallel line in the rumble strip.

Picture 2



A single line in the rumble strip.

Picture 3



An edge line on the road, a parallel dashed line in the rumble strip.

4. Have you ever seen the following types of painted rumble strips? (See images above.)
- | | Yes | No | Don't know |
|--------------|-------------------------|-------------------------|-------------------------|
| a. Picture 1 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| b. Picture 2 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| c. Picture 3 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
5. Have you ever seen one of these patterns at night in the rain?
- | | Yes | No | Don't know |
|--------------|-------------------------|-------------------------|-------------------------|
| a. Picture 1 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| b. Picture 2 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| c. Picture 3 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
- If you answered "No" or "Don't know" to all three, skip to question 6b.
- 6a. Was the visibility of the line in the rumble strip enhanced in comparison to the edge line on the road?
- | | Yes | No | Don't know |
|--------------|-------------------------|-------------------------|-------------------------|
| a. Picture 1 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| b. Picture 2 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
| c. Picture 3 | <input type="radio"/> Y | <input type="radio"/> N | <input type="radio"/> ? |
- 6b. If you knew that a paint line placed on a rumble strip enhanced the visibility of the paint line at night in the rain, which of the three paint patterns would you prefer to see used on Michigan's roadways?
- a. Picture 1 ☐ A
- b. Picture 2 ☐ B
- c. Picture 3 ☐ C
- d. Other
7. Which of the following best describe the benefits that you believe the painted shoulder rumble strips add to Michigan roads? (Check all that apply.)
- a. Improve the visibility of the road at night. ☐ A
- b. Provide warning to drowsy drivers. ☐ B
- c. Alert inattentive drivers who stray off the highway surface. ☐ C
- d. Improve a driver's ability to see the road edge when conditions reduce visibility (such as during rain or snow). ☐ D
- e. Other
8. Please mark whether you agree or disagree with each of the following statements.
- | | Strongly agree | Somewhat agree | Neutral/ no opinion | Somewhat disagree | Strongly disagree | Don't know |
|--|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| a. I use the interstate to get to work and am largely unaware of the rumble strips. | <input type="radio"/> A | <input type="radio"/> A | <input type="radio"/> A | <input type="radio"/> A | <input type="radio"/> A | <input type="radio"/> A |
| b. I was drowsy and hit the rumble strips and they alerted me. | <input type="radio"/> B | <input type="radio"/> B | <input type="radio"/> B | <input type="radio"/> B | <input type="radio"/> B | <input type="radio"/> B |
| c. The rumble strips have warned me when I was distracted on the interstate highway. | <input type="radio"/> C | <input type="radio"/> C | <input type="radio"/> C | <input type="radio"/> C | <input type="radio"/> C | <input type="radio"/> C |
| d. I feel safer using the interstate because of the rumble strips. | <input type="radio"/> D | <input type="radio"/> D | <input type="radio"/> D | <input type="radio"/> D | <input type="radio"/> D | <input type="radio"/> D |
| e. I don't like the rumble strips because of the noise made when I drive over them. | <input type="radio"/> E | <input type="radio"/> E | <input type="radio"/> E | <input type="radio"/> E | <input type="radio"/> E | <input type="radio"/> E |
| f. The rumble strips are unimportant. | <input type="radio"/> F | <input type="radio"/> F | <input type="radio"/> F | <input type="radio"/> F | <input type="radio"/> F | <input type="radio"/> F |

9. Based on the paint patterns shown on page 2 and your understanding of Michigan traffic law, is the use of the shoulder legal or illegal?

	Legal	Illegal	Don't know
a. Picture 1	(A)	(A)	(A)
b. Picture 2	(B)	(B)	(B)
c. Picture 3	(C)	(C)	(C)

LOCATION OF HOME/RESIDENCE

10. From your home (that is, at the address where you received this survey), can you hear any noise from the nearest highway or interstate?

a. Yes	(Y)	} Skip to question 23.
b. No	(N)	
c. Don't know	(?)	

11. In general, how loud is the noise from the nearest highway or interstate? Use a 1 to 5 scale, with "1" being a *little noise* and "5" being *very loud and intrusive*. (1) (2) (3) (4) (5)

12. In general, how often do you hear the noise from the nearest highway or interstate? Use a 1 to 5 scale, with "1" being *very rarely* and "5" being *almost constant*. (1) (2) (3) (4) (5)

13. In general, what types of noises do you hear from the nearest highway or interstate?

Do you hear ...	
a. Truck engines	(A)
b. General traffic sounds	(B)
c. Horns	(C)
d. Radios	(D)
e. Road noise from tires	(E)
f. Rumble strips	(F)
g. Accelerating/slowing traffic	(G)
h. Other	

14. At what times of day do you most frequently hear noise from the nearest highway or interstate?

a. Monday-Friday before 8:00 a.m.	(A)
b. Monday-Friday 8:00 a.m.-12:00 p.m.	(B)
c. Monday-Friday 12:00 p.m.-5:00 p.m.	(C)
d. Monday-Friday 5:00 p.m.-12:00 a.m.	(D)
e. On weekends	(E)

15. Where in or near your house are you most aware of the noise?

a. Working outside in the yard	(A)
b. Indoors	(B)
c. In your car	(C)
d. Other	

16. In a normal week, what are the most typical time periods that you are at home?

a. Monday-Friday before 8:00 a.m.	(A)
b. Monday-Friday 8:00 a.m.-12:00 p.m.	(B)
c. Monday-Friday 12:00 p.m.-5:00 p.m.	(C)
d. Monday-Friday 5:00 p.m.-12:00 a.m.	(D)
e. On weekends	(E)
f. Other	

17. In the past year, do you think the level of noise from the nearest highway or interstate has ...

a. Increased dramatically	(A)
b. Increased some	(B)
c. Stayed about the same	(C)
d. Decreased some	(D)
e. Decreased dramatically	(E)
f. Don't know	(F)

QUALITY OF LIFE

18. Has the noise from **rumble strips** ever caused you to ...

	Yes	No	Don't know
a. Close the windows in your home to limit the noise?	(Y)	(N)	(?)
b. Spend less time doing outdoor activities (e.g., barbecuing, yard maintenance, sports, etc.)?	(Y)	(N)	(?)
c. Write a letter to or call MDOT or a government official?	(Y)	(N)	(?)

19. Has the noise from **the nearest highway or interstate** caused you to ...

	Yes	No	Don't know
a. Close the windows in your home to limit the noise?	(Y)	(N)	(?)
b. Spend less time doing outdoor activities (e.g., barbecuing, yard maintenance, sports, etc.)?	(Y)	(N)	(?)
c. Write a letter to or call MDOT or a government official?	(Y)	(N)	(?)

20. Throughout the year, are you more aware of the noise from **rumble strips** in the...

a. Spring	(A)
b. Summer	(B)
c. Fall	(C)
d. Winter	(D)
e. No difference	(E)
f. Don't know	(F)

21. Throughout the year, are you more aware of the noise from **the nearest highway or interstate** in the ...

a. Spring	(A)
b. Summer	(B)
c. Fall	(C)
d. Winter	(D)
e. No difference	(E)
f. Don't know	(F)

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22. Please read the following statements. *For each statement, mark whether you strongly agree, somewhat agree, somewhat disagree, or strongly disagree.*

Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
(A)	(A)	(A)	(A)
(B)	(B)	(B)	(B)
(C)	(C)	(C)	(C)
(D)	(D)	(D)	(D)
(E)	(E)	(E)	(E)

23. In general, when you think about your experience traveling on roads that have shoulder rumble strips, which statement comes closest to your reaction?

- a. I am pleased with them. (A)
b. I want them removed. (B)
c. They add to the safety of the highways. (C)
d. No comment/unsure/I haven't thought much about them. (D)

BACKGROUND INFORMATION

The following information is collected for statistical purposes only.

24. Approximately how far is your residence from the nearest state highway or interstate, drawing a straight line?

- a. Less than 1/4 mile (A)
b. 1/4 to 1/2 mile (B)
c. 1/2 to 1 mile (C)
d. More than 1 mile (D)
e. Don't know/unsure (E)

25. Which age category are you in?

- a. 18–24 years old (A)
b. 25–34 years old (B)
c. 35–44 years old (C)
d. 45–54 years old (D)
e. 55–64 years old (E)
f. 65–74 years old (F)
g. 75 years old or older (G)

26. What is your employment status? Are you ...

- a. Employed outside the home full time (A)
b. Employed outside the home part time (B)
c. Working at home or retired (C)
d. Other (D)

27. Are you currently taking education or skill-building classes toward a degree?

- a. Yes (Y)
b. No (N)
c. Don't know (?)

28. Are there any children under the age of 18 living in your household?

- a. Yes (Y)
b. No (N)
c. Don't know (?)

29. What is the highest level of education you have completed?

- a. Incomplete high school (A)
b. High school graduate/GED (B)
c. Vocational/technical school or an associate's degree (C)
d. Some college (D)
e. College graduate (E)
f. Postgraduate study or degree (F)
g. Don't know (G)
h. Prefer not to say (H)

30. What is your gender?

- a. Male (A)
b. Female (B)

Thank you!

PLEASE DO NOT WRITE IN THIS AREA



[SERIAL]



OFFICE MEMORANDUM

DATE: November 20, 2003

TO: Region Engineers
Region Delivery Engineers
Region Development Engineers
TSC Managers
Resident/Project Engineers
Region Construction Engineers

FROM: Larry E. Tibbits
Chief Operations Officer

John C. Friend
Engineer of Delivery

SUBJECT: Bureau of Highway Instructional Memorandum 2003 - 17
Upgrading Pavement Markings on Future Pavement
Construction/Reconstruction Projects

The 2004 Appropriations Bill, Enrolled Senate Bill No. 265, Section 611, requires that the Department, "use high-quality pavement marking materials for all state trunkline projects with a design life of ten years or greater." We have reached consensus with industry that a high quality marking system is one providing acceptable visibility for a period of at least three years with no interim reapplication. At the October 3, 2003, meeting of the Engineering Operations Committee, the following recommendations were approved to comply with this requirement.

AFFECTED PROJECTS

The upgrading of pavement markings will apply to all new construction or reconstruction projects for concrete pavements, including unbonded concrete overlays and all new or reconstructed full depth bituminous pavements. Not included are rehabilitation fixes which have a design life in excess of ten years, but also have scheduled maintenance operations in the first two to five years. These maintenance activities would destroy or remove long term pavement markings. All fix types with a design life less than ten years are also not included.

HIGH-QUALITY MARKING OPTIONS

The following pavement marking systems are adequate to provide a life-cycle of three to five years with no yearly remarking, provided the markings are properly applied initially.

Option 1

When the freeway rumble strip can be placed within four inches of the lane edge the following marking system will provide a three year life and wet-night retro reflectivity in the edge line.

Lane Lines and**Skip Lines –**

Four inch wide lines using polyurea marking material in a recessed groove.

Edge Lines –

Six inch wide waterborne paint or spray thermoplastic placed in the rumble strip (only when the rumble strip is within four inches of the edge of the lane). If waterborne paint is used, it will require two initial applications on new pavement surfaces.

Option 2

When a rumble strip is not present or not within four inches of the edge of the lane, the following marking system will provide a three year life.

Lane Lines and**Skip Lines –**

Four inch wide lines using polyurea marking material in a recessed groove.

Edge Lines –

Six inch wide lines using polyurea marking material in a recessed groove.

FUNDING

The funds for upgrading the markings on all affected projects, starting with the 2004 program, will come from project funds. No additional money is available to fund this change. The following is an estimate of the additional funding required for a two lane, two-way pavement. Roadways with more lanes may also be estimated from this information.

CURRENT SYSTEMS

Material	Cost/ft.	Cost/mile	Total Cost/mile
4" waterborne, skip line*	\$.10	\$132.00	\$1,716.00
6" waterborne, edge line	\$.15	\$1584.00	
Metro Region and Urban Areas			
4" spray thermoplastic, skip line	\$.20	\$264.00	\$3,432.00
6" spray thermoplastic, edge line	\$.30	\$3,168.00	

*Estimated at 1,320 ft. of skip line per mile

PROPOSED SYSTEMS

OPTION 1			
Material	Cost/ft.	Cost/mile	Total Cost/mile
4" polyurea, recessed skip line	\$.90	\$1,188.00	\$3,300.00
6" waterborne, edge line in the rumble (2 applications)	\$.20	\$2,112.00	
Metro Region and Urban Areas			
4" polyurea, recessed skip lines	\$.90	\$1,188.00	\$4,356.00
6" spray thermoplastic, edge line in the rumble	\$.30	\$3,168.00	
OPTION 2			
Material	Cost/ft.	Cost/mile	Total Cost/mile
4" polyurea, recessed, skip line	\$.90	\$1,188.00	\$13,650.00
6" polyurea (recessed), edge line	\$1.18	\$12,460.00	

SPECIFICATIONS

The specifications for waterborne paint and spray thermoplastic marking materials are available in the 2003 Standards Specifications for Construction. Special Provisions and plan details for polyurea, cutting the recessing grooves and placing the rumble strips within four inches of the lane line may be obtained by contacting the Pavement Marking Engineer, 517-373-3340.

On applicable projects already under contract, a contract modification must be prepared to upgrade the marking system as described above. For further assistance, contact Lansing Traffic and Safety at 517-373-3340 or 517-335-2625.

EVALUATION

All applications of these high quality marking systems will be evaluated for long-term performance. It is imperative the high-quality marking systems not be restriped under the annual pavement marking program. Please provide the locations of all high-quality marking systems to the Region/TSC pavement marking liaison and the Pavement Marking Engineer in the Lansing Traffic and Safety Support Area. The Pavement Marking Engineer will monitor the performance yearly in the statewide retro reflectivity measurement program and report annually. It is requested that the respective TSC staff visually track the performance on a six-month cycle and report any notable degradation, delamination or material failure to the Pavement Marking Engineer.

Chief Operations Officer

Engineer of Delivery

BOHD:T&S:JDC:bjh

Index: Pavement Marking

cc:	C&T Support Area Staff	MCPA
	Real Estate Support Area, M. DeLong	MCA
	Design Support Area, M. VanPortfleet	MAA
	Maintenance Support Area, C. Roberts	AUC
	Traffic & Safety Support Area, J. Culp	CRAM
	C&T Support Area, B. O'Brien	MRPA
	OEO – S. El Ahmad	ACEC
	C. Rademacher	MPA
	V. Blaxton	MRBA
	G. Moore	MAPA
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